THE

GALLERY

OF

NATURE AND ART;

OR,

A TOUR THROUGH CREATION AND SCIENCE.

VOL. V.

THE

GALLERY

OF

NATURE AND ART;

OR,

A TOUR THROUGH CREATION AND SCIENCE.

BY THE REV. EDWARD POLEHAMPTON,

FELLOW OF KING'S COLLEGE, CAMBRIDGE;

Assisted by Distinguished Writers in the various Departments of the Work.

ILLUSTRATED WITH ONE HUNDRED PLATES,

FROM NEW DESIGNS, DESCRIPTIVE OF THE WONDERS OF NATURE AND ART.

BENEATH HIM, WITH NEW WONDER, NOW HE VIEWS,
IN NARROW ROOM, NATURE'S WHOLE WEALTH.

MILTON.

IN SIX VOLUMES.

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* Misprinted in the running title to the Chapter *Amphibiala*.

THE

GALLERY

OF

NATURE AND ART.

PART I.

NATURE.

BOOK III.

BOTANY.

CHAPTER I.

CHARACTERISTICS OF ANIMALS & VEGETABLES AS DISTINGUISHED FROM FOSSILS & FROM EACH OTHER.

THOSE who with a philosophical eye have contemplated the productions of Nature, have all, by common consent, divided them into three great classes, called the Animal, the Vegetable, and the Mineral or Fossil Kingdoms. These terms are still in general use, and the most superficial observer must be struck with their propriety. The application of them seems at first sight perfectly easy, and in general it is so. Difficulties occur to those only who look very deeply into the subject.

Animals have an organized structure which regularly unfolds itself, and is nourished and supported by air and food; they consequently possess life, and are subject to death; they are moreover endowed with sensation, and with spontaneous, as well as voluntary, motion.

Vegetables are organized, supported by air and food, endowed with life, and subject to death, as well as animals. They have in

some instances spontaneous, though we know not that they have voluntary, motion. They are sensible to the action of nourishment, air, and light, and either thrive or languish according to the wholesome or hurtful application of these stimulants. This is evident to all who have ever seen a plant growing in a climate, soil, or situation, not suitable to it. Those who have ever gathered a rose, know but too well how soon it withers; and the familiar application of its fate to that of human life and beauty is not more striking to the imagination than philosophically and literally true. The sensitive plant is a more astonishing example of the capability of vegetables to be acted upon as living bodies. Other instances of the same kind we shall hereafter have occasion to mention.

The spontaneous movements of plants are almost as readily to be observed as their living principle. The general direction of their branches, and especially of the upper surface of their leaves, though repeatedly disturbed, to the light; the unfolding and closing of their flowers at stated times, or according to favourable or unfavourable circumstances, with some still more curious particulars to be explained in the sequel of this work, are actions undoubtedly depending on their vital principle, and are performed with the greater facility in proportion as that principle is in its greatest vigour. Hence arises a question whether Vegetables are endowed with sensation. As they possess life, irritability and motion, spontaneously directing their organs to what is natural and beneficial to them, and flourishing according to their success in satisfying their wants, may not the exercise of their vital functions be attended with some degree of sensation, however low, and some consequent share of happiness? Such a supposition accords with all the best ideas we can form of the Divine Creator; nor could the consequent uneasiness which plants must suffer, no doubt in a very low degree likewise, from the depredations of animals, bear any comparison with their enjoyment on the whole. However this may be, the want of sensation is most certainly not to be proved with regard to Vegetables, and therefore of no use as a practical means of distinguishing them, in doubtful cases, from Animals.

Some philosophers* have made a locomotive power peculiarly characteristic of Animals, not being aware of the true nature of

* Jungius, Boerhaave, Ludwig, and many others.

those half-animated beings called Corals and Corallines, which are fixed, as immoveably as any plants, to the bottom of the sea, while indeed many living vegetables swim around them, unattached to the soil, and nourished by the water in which they float. Some* have characterized Animals as nourished by their internal, and Vegetables by their external surface, the latter having no such thing as an internal stomach. This is ingenious and tolerably correct; but the proofs of it must fail with respect to those minute and simply-constructed animals the Polypes, and the lower tribes of Worms, whose feelers, put forth into the water, seem scarcely different from roots seeking their food in the earth, and some of which may be turned inside out, like a glove, without any disturbance of their ordinary functions. The most satisfactory remark for a long time perhaps met with on this difficult subject, is that of M. Mirbel, in his *Traité d'Anatomie et de Physiologie Végétales* †, a work I shall often have occasion to quote. He observes ‡, "that plants alone have a power of deriving nourishment, though not indeed exclusively, from inorganic matter, mere earths, salts or airs, substances certainly incapable of serving as food for any animals, the latter only feeding on what is or has been organized matter, either of a vegetable or animal nature. So that it should seem to be the office of vegetable life alone to transform dead matter into organized living bodies." This idea appears to me so just, that I have in vain sought for any exception to it.

Let us however descend from these philosophical speculations to purposes of practical utility. It is sufficient for the young student of Natural History to know, that in every case in which he can be in doubt whether he has found a plant or one of the lower orders of animals, the simple experiment of burning will decide the question. The smell of a burnt bone, coralline, or other animal substance, is so peculiar that it can never be mistaken, nor does any known vegetable give out the same odour.

The Mineral Kingdom can never be confounded with the other two. Fossils are masses of mere dead unorganized matter, subject to the laws of chemistry alone; growing indeed, or increasing by the mechanical addition of extraneous substances, or by the laws

* Dr. Alston, formerly professor of Botany at Edinburgh.

† Lately published at Paris, in two vols. 8vo.

‡ Vol. i. page 19.

of chemical attraction, but not fed by nourishment taken into an organized structure. Their curious crystallization bears some resemblance to organization, but performs none of its functions, nor is any thing like a vital principle to be found in this department of Nature.

If it be asked what is this vital principle, so essential to animals and vegetables, but of which fossils are destitute, we must own our complete ignorance. We know it, as we know its Omnipotent Author, by its effects.

Perhaps in the Fossil Kingdom *heat* may be *equivalent* to a vital principle; but heat is not the vital principle of organized bodies, though probably a consequence of that principle.

Living bodies of animals and plants produce heat; and this phænomenon has not, perhaps, been entirely explained on any chemical principles, though in fossils the production of heat is in most cases tolerably well accounted for. In animals it seems to have the closest possible connexion with the vital energy. But the effects of this vital energy are still more stupendous in the operations constantly going on in every organized body, from our own elaborate frame to the humblest moss or fungus. Those different fluids, so fine and transparent, separated from each other by membranes as fine, which compose the eye, all retain their proper situations (though each fluid individually is perpetually removed and renewed) for sixty, eighty, or a hundred years, or more, while *life* remains. So do the infinitely small vessels of an almost invisible insect, the fine and pellucid tubes of a plant, all hold their destined fluids, conveying or changing them according to fixed laws, but never permitting them to run into confusion, so long as the vital principle animates their various forms. But no sooner does *death* happen, than, without any alteration of structure, any apparent change in their *material* configuration, all is reversed. The eye loses its form and brightness; its membranes let go their contents, which mix in confusion, and thenceforth yield to the laws of chemistry alone. Just so it happens, sooner or later, to the other parts of the animal as well as vegetable frame. Chemical changes, putrefaction and destruction, immediately follow the total privation of life, the importance of which becomes instantly evident when it is no more. It is hence, therefore, to be conceived, that if the human understanding can in any case flatter itself with obtaining, in

the natural world, a glimpse of the *immediate agency* of the Deity, it is in the contemplation of this *vital principle*, which seems independent of material organization, and an impulse of his own divine energy.

CHAPTER II.

ON SYSTEMS AND CLASSIFICATIONS.

THE human mind is unable to take in the various forms of the vegetable kingdom at one view: it must therefore have recourse to some contrivance in order to facilitate the acquisition of knowledge, and to satisfy its curiosity. It attains its object in the most perfect manner when it reduces its knowledge to a system.

A botanical system is a list of all the plants hitherto discovered, arranged according to certain characters, and their deviations from them. When a person has once accustomed himself to some system, his progress will be doubled, and he will form a much better judgment of plants than he was able to do before.

There have been men of high abilities who have maintained, that all nature might be reduced to system; there have, on the contrary, been other great men who have denied the truth of this position, and have rejected all systematic arrangement, or even the least trace of it. Others again, and indeed the greatest number, believe that that there is no real system of nature, but that there is a chain of beings.

Nature connects the most multifarious bodies by their form, size, colours, and qualities. Each individual body, each plant has some affinity with several others, and this goes on to infinity. But who is able to declare the order followed by nature? All affinities and natural arrangements are but apparent traces of a natural system. By a more accurate investigation, we find those boasted affinities not so great, and the natural arrangements not so luminous. We endeavour, by our systematic divisions, to arrange bodies in straight lines; but nature forms in the whole an intricate and infinite ramifi-

cation, which we are too short-sighted to perceive, and too superficial to fathom. Perhaps in some centuries hence, when every corner of the globe has been examined, and multiplied experience has distinguished what is true from what is false, we may be able to judge more soundly of the order of nature.

But though a true natural system has not been discovered, it cannot be denied that some plants are allied by such very striking resemblances, that they may be considered as belonging to natural classes. Those resemblances, however, extend but to few plants, and there are many wanting to connect one natural family with another. These affinities, however, have been sufficient to enable botanists to arrange plants by their external characters, and this arrangement has been called a Natural System, (*Systema naturale.*)

Other botanists have founded their systems on the number, proportion, and agreement of minute and not very obvious parts, and such a system has been called Artificial, (*Systema artificiale.*)

Others again select the sexual parts as the distinctive characters, and found their system on the number and variety of these parts. This is called the Sexual System, (*Systema sexuale.*)

A System is first divided into classes and orders. In each system a certain part of plants, such as the flower, the fruit, &c. is assumed as the foundation, and upon that, classes, orders, and genera are constructed. When a particular investigated character is common to many plants, these plants make a Class, (*classis*). Should some of the plants, beside the particular character of the class, agree in another character, these form an Order, (*ordo*). And if a few of the plants, which already agree in two of the characters, are found to possess others in common, these are called a *Genus*. Each of the plants in this last division is called a *Species*. It is necessary in a species that it remain always the same from seed. A Variety, (*varietas*,) is a species that differs only in colour, size, or in some accidental circumstance. From the seed the variety changes at last into the true species.

From a good system we expect that the part selected, according to which the classes, orders, and genera are framed, shall be easily seen, and without difficulty found; and that it shall be common to all plants, and not subject to variation. Besides, no system ought to be divided according to any other character than that first

selected. No good system should have too many subdivisions, and, if possible, should only consist of classes and orders. The orders should likewise be founded only on one part.

For a beginner it is very convenient to be acquainted with several systems, especially if at the same time he knows the defects of each, that he may be able, by his own experience, to have recourse to that which particularly suits him. We shall here give a view of the principal systems, in the language in which they were originally written; and should any term occur which is not to be found in general use, we shall briefly explain it.

Cæsalpinus was the first botanist who invented a system. He selected the fruit, and the situation of the corculum, as the distinguishing characters. His system has fifteen classes, viz.

1. Arbores, corculo ex apice seminis.
2. ——— ——— a basi seminis.
3. Herbæ, solitariis seminibus.
4. ——— ——— baccis.
5. ——— ——— capsulis.
6. ——— binis seminibus.
7. ——— ——— capsulis.
8. ——— triplici principio, fibrosæ.
9. ——— ——— ——— bulbosæ.
10. ——— quaternis seminibus.
11. ——— pluribus seminibus. Anthemides.
12. ——— ——— ——— Cichoraceæ *s.* Acanaceæ.
13. ——— flore communi.
14. ——— follicullis.
15. ——— flore fructuque carentes.

This system is, for our times, when such a multitude of plants have been discovered, no longer of use. Considered as the first attempt at system it is entitled to great consideration. The fruit is a very constant part, and this classification would be particularly commendable, if plants and trees had not been separated. In the two first classes trees are distinguished according to the situation of the corculum; the other classes are arranged according to the fruit of the plants. The eighth and ninth classes have a trilocular capsule, and are distinguished according to the situation of the corculum; the other classes are arranged according to the fruit of the plants. The eighth and ninth classes have a trilocular capsule, and

are distinguished according as the root is either fibrous or bulbous. The eleventh, twelfth, and thirteenth classes contain the compound flowers; the twelfth, semifloscular flowers; the thirteenth, discoid flowers. The fourteenth class contains such plants as bear several capsules together, as the ranunculus, anemone, &c. The last class includes Mosses, Algæ, Fungi, and Filices. The ancients believed that these plants produced neither flowers nor seeds.

Morison constructed his system according to the flower, and the external appearance of the plant. He has eighteen classes:

1. Lignosæ, Arbores.
2. ——— Frutices.
3. ——— Suffrutices.
4. Herbaceæ, Scandentes.
5. ——— Leguminosæ.
6. ——— Siliquosæ.
7. ——— Tricapsulares.
8. ——— a numero capsularum dictæ.
9. ——— Corymbiferæ.
10. ——— Lactescentes. *s*. papposæ.
11. ——— Culmiferæ *s*. Calmariæ.
12. ——— Umbelliferæ.
13. ——— Tricoccæ.
14. ——— Galeatæ.
15. ——— Multicapsulares.
16. ——— Bacciferæ.
17. ——— Capillares.
18. ——— Heteroclitæ.

The defect of this system, as of all the old systems, consists in the various foundations of the division, and in separating trees and plants. By Suffrutices, Morison means small shrubs, but not according to the modern definition. Even some moderns use the term *Suffrutex* for a small shrub. The fourth class contains all twining plants, as the Cucurbita, Convolvulus, &c. The seventh class includes plants which have a trilocular capsule. In the eighth class are plants that have sometimes more, sometimes fewer cells in the capsules. The ninth class contains the compound flowers that have no pappus, or at least only a membranaceous one. In the tenth class are all the compound flowers that have a plumose, pilose, setaceous, &c. pappus. To the eleventh class belong all the grasses

and plants allied to them; to the twelfth, the umbelliferous plants; to the thirteenth, those which have a trilocular capsule. The fourteenth class contains the ringent or labiated flowers; the seventeenth contains only the Filices; and the eighteenth includes the Mosses, Algæ, Fungi, and Corals. It is to be regretted that Morison often arranges plants in a class to which they do not belong.

Hermann made use of the fruit, of the flower, and also, but on few occasions, of the external appearance, in framing his system.

Herbæ gymnospermæ.	
1. Monospermæ.	Simplices.
2. ———	Compositæ.
3. Dispermæ.	Stellatæ.
4. ———	Umbellatæ.
5. Tetraspermæ.	Asperifoliæ.
6. ———	Verticillatæ.
7. Polyspermæ.	Gymnopolyspermæ.
Herbæ Angiospermæ.	
8. Bulbosæ.	Tricapsulares.
9. Capsula unica.	Univasculares.
10. Capsulæ binæ.	Bivasculares.
11. ——— tres.	Trivasculares.
12. ——— quatuor	Quadrivasculares.
13. ——— quinque	Quinquevasculares.
14. Siliqua.	Siliquosæ.
15. Legumen.	Leguminosæ.
16. Multicapsulares	Multivasculares.
17. Carnosæ.	Bacciferæ.
18. ———	Pomiferæ.
Herbæ Apetalæ.	
19. Calyculatæ.	Apetalæ.
20. Glumosæ.	Stamineæ.
21. Nudæ.	Muscosæ.
Arbores.	
22. Incompletæ.	Juliferæ.
23. Carnosæ.	Umbilicatæ.
24. ———	Non Umbilicatæ.
25. Non carnosæ.	Fructu sicco.

This system is to be preferred to those already mentioned: only the separation of trees and plants is reprehensible. But to make it

useful in the present times, it would need great amendment. The above enumeration of the classes renders any further explanation unnecessary.

Christopher Knaut has also chosen the fruit as the foundation of his system, but with this difference, that he has taken into account the number of the petals and the regularity of the flower. His system has a great resemblance to the first of Ray.

Boerhaave has constructed his system partly from that of Hermann, Tournefort, and Ray. He too has separated trees and plants. The number of the capsules, of the petals, and of the cotyledons is made use of.

Ray conjoins fruit, flower, and external appearance, like his predecessors. As his system has something peculiar, I shall here detail it.

1. Herbæ, Submarinæ.
2. —— Fungi.
3. —— Musci.
4. —— Capillares.
5. —— Apetalæ.
6. —— Planipetalæ.
7. —— Discoideæ.
8. —— Corymbiferæ.
9. —— Capitatæ.
10. —— Solitario semine.
11. —— Umbelliferæ.
12. —— Stellatæ.
13. —— Asperifoliæ.
14. —— Verticillatæ.
15. —— Polyspermæ.
16. —— Pomiferæ.
17. —— Bacciferæ.
18. Herbæ, Multisiliquæ.
19. —— Monopetalæ.
20. —— Di—Tripetalæ.
21. —— Siliquosæ.
22. —— Leguminosæ.
23. —— Pentapetalæ.
24. —— Floriferæ.
25. —— Stamineæ.
26. —— Anomalæ.
27. —— Arundinaceæ.
28. Arbores, Apetalæ.
29. —— Fructu umbilicato.
30. —— — non umbilicato.
31. —— — sicco.
32. —— — siliquoso.
33. —— Anomalæ.

The old system of Ray has only twenty-five classes, and is consequently more imperfect than this improved one. He still retains the old division of trees and plants. In the first class stand all the Fuci, Zoophytes, and Corals. In the fifth all plants that have no petals: in the sixth the semifloscular flowers; in the seventh the discoid and radiate flowers that have pilose pappus; in the eighth class are those same flowers, but which have no pappus; and in the ninth class stand all those capitated compound flowers which have a membra-

neous pappus. The twelfth class contains plants with verticillated flowers, that at the same time have a corolla of four petals and two naked seeds. Under the thirteenth class are arranged all the rough-leaved plants, that bear a monopetalous tubular corolla, and four naked seeds. To the fourteenth belong the labiated or ringent flowers. In the twenty-fourth class stand all the Lilies. To the twenty-fifth belong all the Grasses, and to the twenty-sixth those which cannot be reduced under any of the foregoing.

Camellus has attempted a very singular system, framed from the valves of the capsule and their number. It is not, however, on account of its shortness, of great use.

1. Pericarpia Afora.
2. .... Unifora.
3 .... Bifora.
4. .... Trifora.
5. Pericarpia Tetrafora.
6. .... Pentafora.
7. .... Hexafora.

Rivinus selects only the corolla, the regularity of the petals, and their number.

Flores regulares.

1. Monopetali.
2. Dipetali.
3. Tripetali.
4. Tetrapetali.

Flores regulares.

5. Pentapetali.
6. Hexapetali.
7. Polypetali.

Flores compositi.

8. Ex flosculis regularibus.
9. Ex flosculis regularibus et irregularibus.
10. Ex flosculis irregularibus.

Flores irregulares.

11. Monopetali.
12. Dipetali.
13. Tripetali.
14. Tetrapetali.

Flores irregulares.

15. Pentapetali.
16. Hexapetali.
17. Polypetali.
18. Flores incompleti. Imperfecti.

This system is very easily understood, and the selected character is to be found without any trouble. But the regularity of the corol, which often varies in the different species of a genus, and the number of petals, which likewise not unfrequently vary, make it difficult in practice. The orders are taken from the fruit according as it is naked, *(fructus nudus)*, or contained in a pericarp; and this last is distinguished according as it is dry *(pericarpium siccum)*, or *(pericarpium carnosum)*.

Christopher Knaut has adopted Rivinus's method almost unchanged, but in some degree reversed. The classes he forms from the number of the petals, and his subdivisions he takes from their regularity or irregularity. But he denied that there were any flowers without a corol, or that there was such a thing as naked seeds.

The system of Tournefort was for a considerable time the favourite system of all botanists, and it deserves particular attention.

Herbæ et suffrutices.

1. Floribus monopetalis campaniformibus.
2. ...., infundibuliformibus et rotatis.
3. .... anomalis.
4. .... labiatis.
5. ...... polypetalis cruciformibus.
6. .... rosaceis.
7. .... umbellatis.
8. .... caryophyllæis.
9. .... liliaceis.
10. .... papilionaceis.
11. .... anomalis.
12. ...... flosculosis.
13. ...... semiflosculosis.
14. ...... radiatis.
15. ...... apetalis et stamineis.
16. Qui floribus carent et semine donantur.
17. Quorum flores et fructus conspicui desiderantur.

Arbores et frutices.

18. Floribus apetalis.
19. ...... amentaceis.
20. ...... monopetalis.

Arbores et frutices.

21. Floribus rosaceis.
22. ...... papilionaceis.

The form of the corol, which Tournefort properly employs as the ground-work of his system, appears to make it very easy and intelligible. But the figure of the corol is so various, that it is often with difficulty described. Besides, some species of corol so much resemble others, that they are not easily distinguished. It is on this account chiefly that Tournefort's system is not used in these days. The orders in his method are taken from the style and from the fruit. When the germ is under the flower he says, "*calyx abiit in fructum*;" when it is included in the flower he says, "*pis-*

tillum abiit in fructum." The fruit is also more accurately distinguished, as it is a capsule, berry, &c.

We shall here pass by several of the less important systems that are merely alterations of the foregoing. These alterations consist sometimes of a single circumstance, of which the former authors had taken no notice. Of this Pontedera may serve as an instance. He took Tournefort's system, and combining it with that of Rivinus, only separated the plants that bear buds from those that have none. Another more worthy of consideration is that of Magnolius; though it too is of little use in practice. He forms his classes intirely on the calyx. Many similar systems may be found in Adanson, an eminent naturalist, who has exhibited upwards of sixty systems, and has shewn evidently that many more might be formed, if science were to derive any benefit from the labour.

The systems we have detailed are either built on the fruit or the flower, and their parts: but none before Gleditsch had attempted one on the situation of the stamens. His classes are the following:

1. Thalamostemonis.
2. Petalostemonis.
3. Calycostemonis.
4. Stylostemonis.
5. Cryptostemonis.

The insertion of the stamens here forms the classes: in the first class they stand on the receptacle; in the second on the corol; in the third on the calyx; in the fourth on the style; and to the fifth class belong plants whose flowers are inconspicuous, as the Filices, Musci, Algæ, and Fungi. The orders are formed according to the number of the anthers; that is, whether they are one or more in a single flower, *viz.* Monantheræ, Diantheræ, &c. But as there are so few classes, it is obvious that the orders must have many subdivisions; and this is the only objection to this, otherwise, very elegant system, which stands in the way of its further usefulness.

The same system has been lately somewhat changed by Monch. His classes are,

1. Thalamostemon.
2. Petalostemon.
3. Parapetalostemon, *i. e.* when the stamens stand upon leaves similar to petals, which are found in the corol.
4. Calycostemon.
5. Allagostemon, when the stamens stand alternately on the calyx and petals.
6. Stylostemon, when they stand on the style.

7. Stigmatostemon, when they are inserted in the stigma.
8. Cryptostemon.

The orders he has taken from the differences in the fruit; but as some classes were too large, he was obliged to take his subdivisions from other parts of the flower.

Haller endeavoured, very ingeniously, to frame a natural system on the cotyledons, the calyx, the corol, the stamens, and the sexes of plants. His classes, of which he afterwards found it necessary to make some little alteration, are the following:

1. Fungi.
2. Musci.
3. Epiphyllospermæ.
4. Apetalæ.
5. Gramina.
6. Graminibus affinia.
7. Monocotyledones. Petaloideæ.
8. Polystemones.
9. Diplostemones.
10. Isostemones.
11. Mejostemones.
12. Staminibus sesquialteris.
13. ——— sesquitertiis.
14. —— quatuor. Ringentes.
15. Congregatæ.

To the third class belong all the Filices. To the seventh all the Lilies: in the eighth class stand all those plants whose filaments exceed in number the segments or petals of the corol three or four times. To the ninth class belong all those plants which have twice as many filaments as there are segments or petals in the corol. To the tenth belong those that have the same number of filaments as there are segments or petals in the corol. In the eleventh class are included all those plants whose filaments are fewer in number than the segments or petals of the corolla. To the twelfth belong all the cruciform plants; to the thirteenth, all the papilionaceous; and to the fourteenth, the ringent or labiated flowers with four stamens. The last class contains all the compound flowers. The orders in this system are taken from all parts of the flower and of the fruit.

Royen and Wachendorf have constructed similar systems, the first of which deserves the preference. But all these systems are attended with difficulty, on account of the various parts of plants which we must have constantly in view, and the great number of subdivisions which they necessarily require.

Linnæus, in his System, has fixed upon the stamina as the foundation of his divisions.

1. Monandria,
2. Diandria,
3. Triandria,
4. Tetrandria,

5. Pentandria,
6. Hexandria,
7. Heptandria,
8. Octandria,
9. Enneandria,
10. Decandria,
11. Dodecandria,
12. Icosandria,
13. Polyandria,
14. Didynamia,
15. Tetradynamia,
16. Monadelphia,
17. Diadelphia,
18. Polyadelphia,
19. Syngenesia,
20. Gynandria,
21. Monoecia,
22. Dioecia.
23. Polygamia,
24. Cryptogamia.

From the first to the tenth class the stamens are numbered. To the eleventh class belong all the plants that have from ten to nineteen stamens. To the twelfth class those plants which have many stamens inserted in the calyx. The thirteenth class contains plants that have a great number of stamens from twenty to one thousand in one flower. The fourteenth consists of plants that have four stamens in one flower, of which two are longer than the rest. In the fifteenth class stand those which have six stamens, of which two are shorter than the rest. The sixteenth class contains plants whose filaments are connected and form a cylinder. In the seventeenth class stand those plants whose filaments are united in two parcels. To the eighteenth class belong those plants whose filaments are united in several parcels. In the nineteenth class stand those plants whose antheræ are united in a cylinder. The twentieth class consists of those plants whose stamens stand upon the style; the twenty-first consists of flowers of different sexes, namely, male and female on one plant; the twenty-second, of male and female flowers, but so divided that one plant bears only male flowers, the other only female; the twenty-third has flowers of both sexes and hermaphrodite flowers together, so that the plant contains either male and hermaphrodite flowers or female and hermaphrodite flowers. To the last class belong all plants whose flowers are not visible to the naked eye, these are the Filices, Musci, Algæ and Fungi.

The orders in most of the classes are taken from the style, in some from the fruit, and in the last classes from the filaments. From the first to the thirteenth class the orders are taken from the style, viz. *monogynia* where there is only one style in the flower, two, three, four, &c. styled, (*di*, *tri*, *tetra*, *&c. polygynia*), ac-

cording to their number. In general we count to six, and then say, *polygynia*. If there should be several germens and but one style, the style only is numbered. The orders are never taken from the germens except when the style is wanting. The Orders of the fourteenth class are taken from the fruit; there are two, viz. *Gymnospermia* when the seeds are naked, and *Angiospermia* when they are contained in a pericarp. Those of the fifteenth class are, like the foregoing, taken from the fruit, with this difference, that here there are no naked seeds but a Siliqua, and the Orders are named according to the size of this, *siliculosa* and *siliquosa*. In the sixteenth, seventeenth, eighteenth, twentieth, twenty-first and twenty-second classes, the Orders are denominated according to the number of the stamens; in the 16th, 17th, 18th and 20th, they are numbered from Diandra upwards; in the 21st and 22d from Monandria.

The 19th Class contains none but compound flowers, except a very few. Linnæus considers these flowers as a Polygamy, (*polygamia*), and prefixes this word to the name of each Order in which the compound flowers are contained;—for example:

Polygamia æqualis, when all the florets which a compound flower contains are hermaphrodites, and similar in form, whether they be ligulate or tubular.

Polygamia superflua, when the compound flower is radiate; the disk bearing hermaphrodite florets; and the ray, fertile florets.

Polygamia frustanea, when the compound flower is radiate, the disk consisting of fertile, hermaphrodite florets, and the ray of barren female florets.

Polygamia necessaria, when the compound flower is radiate, the disk consisting of barren hermaphrodite florets, the ray of fertile female florets.

Polygamia segregata, when in a compound flower besides the common perianth, each floret is furnished with its own particular calyx.

Monogamia is an Order containing all the plants which according to strict system belong to this class, though they are not compound flowers.

The plants of the 21st and 22d classes, as we have said already, are divided into Orders according to the number of the stamens; but besides these, here are two orders taken from the connection

of the filaments and antheræ, namely, *Monadelphia* and *Syngenesia*. The last Order of both classes is called *Gynandria*; not because in the plants which belong to it, the stamina stand upon the style; but because in the male flowers there is a production resembling a style to which the stamina are attached. This production Linnæus considers as an imperfect pistulum.

In the 23d class the Orders are called *Monœcia*, *Diœcia*. The last class has the following Orders, *Filices*, *Musci*, *Algæ*, and *Fungi*.

From the aforegoing analysis it will be seen that the Linnæan system consists of an artificial and sexual arrangement, and that it does not answer the idea, we have given above, of a perfect system. But till such a one is found out, a system partly natural, partly artificial is the best; we must, however, as we cannot deny the usefulness of Linnæus's system, point out its defects.

Linnæus endeavoured, from the number of the stamina, their various lengths, and different modes of connection, to unite a natural classification with an artificial one. Hence arose some faults, which would not have happened had he, at the same time, made use of the corola as a character. For instance, in the fourteenth class are contained the labiated and ringent flowers; but because Linnæus characterised it from the four stamens, two of which are shorter; there are some of these plants which must stand in the second class, and others in the fourth, though they properly belong to this class. In the same manner, all the papilionaceous flowers are referred to the seventeenth class; but the assumed character, viz. that the filaments are united into two sets, is not to be found in all these plants. Many have the filaments united in one cylinder; and in the tenth class stand many plants with papilionaceous flowers. These two faults are not the greatest which may be attributed to this system: it is a more important objection that Linnæus has numbered the stamens in the first classes without attending to their insertion, while in the twelfth he remarks that they are inserted in the calyx, and in the twentieth, that they stand on the pistillum. In the nineteenth class are comprehended all the compound flowers, and yet he drags into the last order of this class other plants whose antheræ are only sometimes united. It is also to be regretted, that in the 21st, 22d and 23d classes, Linnæus has taken notice of different sexes in the same plant, which he had not done before; there being many plants in the former classes that properly belong to these.

These defects and some others, from which no system can easily be exempted, have suggested to several botanists the possibility of correcting them and making the system more useful. Among all the improvements of the Linnæan system, those by Thunberg, seem to be the chief. He has reduced the number of classes to twenty, by referring the plants of the 20th, 21st, 22d and 23d classes to others, according to the number or connection of the stamens.

All the plants which stand in the 20th class ought to have the stamens placed upon the style; but the most of the plants arranged by Linnæus in this class wants these characters, the genus of Orchis alone excepted. The three following classes are not always constant with regard to sex; a difference of climate will sometimes remove a plant from the class Monœcia to that of Polygamia.

Liljebad has made the following changes on the Linnæan system. He joins the 7th, 8th and 9th classes to the 10th. His Decandria thus contains the Heptandria, Octandria, Ennæandria and Decandria of Linnæus. The eleventh class he joins to the 13th. The 18th, 21st, 22d, and 23d he includes in one. Thus his system contains only sixteen classes, viz.

1. Monandria,	9. Polyandria,
2. Diandria,	10. Gynandria,
3. Triandria,	11. Didynamia,
4. Tetrandia,	12. Tetradynamia,
5. Pentandria,	13. Monadelphia,
6. Hexandria,	14. Diadelphia,
7. Decandria,	15. Syngenesia,
8. Icosandria,	16. Cryptogamia.

Some other botanists have changed the orders of the 19th class, by leaving out the word *Polygamia*, and removing the plants of the order Monogamia to other classes.

But this order of the 19th class ought to be altogether suppressed; because the genera belonging to it have nothing in common with the other syngenesious flowers but the united anthers, which other genera, for instance, the Solanum, possesses likewise. If this order be taken away, the class becomes perfectly natural.

Schreber, in the last edition of the Genera Plantarum, has changed the Orders of the 24th class, as follows:

1. Miscellanæa.	4. Hepaticæ.
2. Filices.	5 Algæ.
3. Musci.	6. Fungi.

It would be superfluous here to take notice of other alterations which do not tend to the improvement of the science.

[*Wildenow.*

CHAP. III.

NATURAL HISTORY OF PLANTS.

By the Natural History of Plants, we mean a comprehensive view of the effects of Climate on Vegetation; the changes which it is probable plants undergo from the revolutions of our globe; their dispersion over its surface; their migration; and, lastly, the means pursued by Nature for their preservation.

Geographers have imagined the globe to be surrounded by certain Zones, and they have divided these into degrees and circles. They suppose the hottest climate to be under the line, or at the equator; a hot climate under the tropics; between these and the polar circles, two different climates, a temperate and a cold; and, lastly, they consider, under the polar circle, a very cold climate to prevail.

Upon the whole, these divisions sufficiently coincide; but great differences are produced by mountains, vallies, rivers, marshes, woods, seas, and inequalities of surface; so that there are places which, according to the above divisions, ought to be hot, which are however temperate, or even cold, and *vice versa*. We must therefore distinguish between a physical and geographical climate. America and Asia are much colder in the same northern geographical latitude than our part of the world. Plants which in America grow under the 42d degree of northern latitude, bear in our climate the cold of 52°. The reason of this great difference seems to be the enormous swamps and woods of America, and the immense elevation of the land in Asia. Africa, under the tropics, is incomparably warmer than Asia or America. The chains of mountains in these last countries, and the humidity of the vallies, moderate the great heats, while the burning sands, of which almost the

whole of the African surface consists, increases the heat. The regions about the North Pole are much more temperate than those at the South Pole. Tierra del Fuego lies under the 55th degree of southern latitude, and has a much more inclement sky than prevails in Europe under the 60th. Mountains that raise themselves high above the clouds, have, in all latitudes, perennial snow upon their extreme summits. Cook found such a mountain in the Sandwich islands; and in America, the celebrated Andes have their tops covered with perpetual ice under the tropics and the line, while a constant summer is felt in the vallies.

Situation, heat and cold, wet and dry soils, have great influence on the whole of vegetation. It is not therefore surprising to find in every region of the globe, plants adapted to each particular situation. Accordingly, when we meet on the tops of high mountains the plants of Polar regions, we infer that these plants were destined for cold climates: nor ought we to wonder that, under the same latitudes in Asia, Africa, and America, we find, on similar soils, plants which are native in all these quarters of the globe.

In one geographical latitude, if no mountains or other circumstances change the temperature, the same plants are found to grow; but places in the same longitude, must always exhibit various productions of the vegetable kingdom. The Mark of Brandenburgh, the coasts of Labrador and Kamtschatka, lie nearly under the same latitude, and produce therefore many plants in common. Berlin, Venice, Tripoli, and Angola, are nearly in the same longitude; but their plants are very different.

It is well known that warmth is necessary to vegetation: hence it naturally follows, that in the warmer climates, the number of native plants will be most considerable. The Floras, made by botanists in different countries, shew, that vegetation increases according to the degree of heat. In Southern Georgia*, by the best accounts, there are only two native plants: in Spitzbergen, there are 30: in Lapland 534: in Iceland, 553: in Sweden, 1299: in the Mark of Brandenburgh, 2000: in Piedmont, 2800: on the

* An island of considerable extent discovered by La Roche, in 1675, and explored by Captain Cook in 1775, who named it Georgia. It is a land of ice, and snow, with few vegetables but lichens.—EDITOR.

coast of Coromandel, nearly 4000: as many in the island of Jamaica: in Madagascar, above 5000. In every region there are plants, except in the regions round the pole covered with perpetual snow, on the icy tops of the highest mountains, and in the dry and sandy wastes of Africa. On the bare and barren places where volcanic fires predominate, there are to be found few plants, and those miserably stunted; as in the island of Ascension and Kerguelen's land.

Climate influences the growth, as well as the form, of every vegetable product. The plants of the polar regions, and of high mountains, are low, with very small and close-set leaves, but with flowers proportionally large. The plants of Europe have no very showy flowers, and many of them are catkins: the Asiatic climates are particularly rich in splendid flowers: the African plants have, for the most part, very succulent leaves and variegated flowers. American plants are remarkable for long smooth leaves, and the singular structure of their flowers and fruits. The plants of New Holland are distinguished by thin dry leaves, and a more compressed form. Those of the Archipelago in the Mediterranean Sea, are in general shrubby and prickly. The plants of Arabia are of a low and stunted growth. In the Canaryisl ands, the most of the plants and even genera that in other climates are herbaceous, become either shrubs or trees.

The resemblance between the trees and shrubs of northern Asia and America is remarkable, though the herbaceous and perennial plants of both these parts of the world have almost nothing in common, with respect to form. The following comparative list will make this apparent:

In northern Asia grow	*Corresponding Plants in North America.*
Acer *cappadocicum*	Acer *saccharinum.*
Acer *Pseudoplatanus*	Acer *montanum.*
Azalea *pontica*	Azalea *viscosa.*
Betula *davurica*	Betula *populifolia.*
Alnus *glutinosa*	Alnus *serrulata.*
Corylus *Colurna*	Corylus *rostrata.*
Cratægus *sanguinea*, Pall.	Cratægus *occinea*,

In northern Asia grow	*Corresponding Plants in North America.*
Cornus *sanguinea*	Cornus *alba.*
Fagus *sylvatica*	Fagus *latifolia.*
Fagus *Castanea*	Fagus *pumila.*
Juniperus *lycia*	Juniperus *virginiana.*
Liquidambar *imberbe*	Liquidambar *styraciflua.*
Morus *nigra*	Morus *rubra.*
Lonicera *Periclymenum*	Lonicera *sempervirens.*
Pinus *sylvestris*	Pinus *inops.*
Pinus *Cembra*	Pinus *Strobus.*
Platanus *orientalis*	Platanus *occidentalis.*
Prunus *Laurocerasus*	Prunus *caroliniana.*
Rhododendron *ponticum*	Rhododendron *punctatum.*
Rhus *Coriaria*	Rhus *typhinum.*
Ribes *nigrum*	Ribes *floridum.*
Rubus *fruticosus*	Rubus *occidentalis.*
Sambucus *nigra*	Sambucus *canadensis.*
Styrax *officinale*	Styrax *lævigatum.*
Thuya *orientalis*	Thuya *occidentalis.*
Tilia *europæa*	Tilia *americana.*
Ulmus *pumila*	Ulmus *americana.*
Viburnum *orientale*	Viburnum *acerifolium,*
	&c. &c.

Between the shrubs of the Cape of Good Hope and those of New Holland, there is likewise a great resemblance. May we not suppose an agreement in respect of soil or situation, at the creation of organic bodies, to have produced the resemblance which we here discover?

In cold climates, the plants of the class Cryptogamia are most numerous; there are some tetradynamious, umbelliferous and syngenesious plants; but few trees or shrubs.

In warm climates are found most trees and shrubs, many Filices, twining, parasitical, succulent, and lilaceous plants, Bananas and Palms. Herbaceous and annual plants vegetate only in the rainy season. Those with pinnated and strongly veined leaves are found chiefly in tropical countries.

Aquatic plants, while they remain under water, have their leaves finely divided; but when they rise above the surface of the water, the leaves become broad, rounder, and at the base more or less emarginated.

Plants that grow in elevated situations are the reverse, with respect to the form of their leaves, of those that grow in water. Their radical leaves are more or less intire; but the stem leaves, the higher they rise, are always the more minutely divided. Examples of this we have in the Scabiosa *Columbaria*, Valeriana, &c.

Plants in their wild state remain pretty constant in their appearance, though they vary sometimes; but these variations are inconsiderable, in comparison of what they undergo when they become objects of culture. It is remarkable, that both plants and animals are no sooner domesticated than they begin to change their shape, their colour and taste. Alpine plants, or those of the polar regions, become, in vallies or gardens, very much larger; their leaves increase in length and breadth, but their flowers grow smaller, or at least do not increase. The plants of warm countries have so different an appearance from that they have with us, that an inexperienced botanist does not know them in their native places. How endless are the varieties we find in our orchards and kitchen gardens.

Now, whence comes the great number of distinct plants which our earth produces! Were these all created originally, or have new species appeared since, in consequence of mixture with one another? It is difficult to give a satisfactory answer to these questions. Linnæus and some other botanists have supposed, that nature originally formed nothing but genera, and that the species were produced afterwards by the mixture of these. This hypothesis, however, seems untenable. In our days, we ought to see new species formed by the mixture of various genera, and experiments would confirm the fact. If it was possible for the infinite power which called every thing into existence to create genera, why should it not also have formed species? We find too much harmony, too much uniformity in nature, and see so much consistency in the machinery of it, to doubt that the wise Creator of the whole did not give at the beginning to all organized bodies the forms we now see them in. Many genera of plants, however, of which in some countries there are very numerous species, may perhaps, by mixture, have produced a new one. We find, for instance, at the Cape of Good Hope, of

the genus Erica, nearly 200 species, of Stapelia above 50, of Ixia and Gladiolus 58, of Protea above 70, of Mesembryanthemum about 180, not to mention other genera which likewise contain numerous species. The great resemblance between some of these, which makes it difficult to find characters to distinguish them by, gives some colour to the supposition.

It is now well known, that fertile hybrids are not uncommon in the vegetable kingdom. We find this occurrence in our gardens, and cannot deny that it may sometimes happen in the fields. Nature, however, has wisely provided, that in a wild state an intimate mixture cannot easily take place in plants. Those that nearly resemble one another, we find growing in very distant regions, flowering at different times, or placed in dissimilar situations. It is only congenerous plants that can mix and produce hybrids; nor can even that happen, unless many species of a genus grow in a given spot. Let us give an example of this position. We have, in various places, three species of Scrophularia growing wild; namely, the Scrophularia *verna*, *nodosa*, and *aquatica*. The first grows about the villages in hedges, and flowers in the spring; the second is found in moist pastures, and flowers a month later: the third grows in rivers, marshes, and ponds, and flowers a month later than the second. Other species of this genus, which resemble the above, grow in Italy, Siberia, in the East, in North America, &c. By none of these can any spurious breed be produced in their native situations. But if we bring all the foreign and indigenous species of the genus together, and place them in a botanic garden, would it be surprising if, in a soil to which they are not accustomed, some should flower sooner and some later than is natural to them, and by the additional means of the insect tribe, flying from one to another loaded with impregnating pollen, a hybrid should appear among them? We shall soon find a number of plants that never originally grew wild, but owe their existence solely to botanic gardens.

The numerous varieties of our fruits have certainly had their origin in this spurious method of impregnation, and perhaps some that pass for species have been produced in the same way. It is probable that Pyrus *dioica*, *Pollveria*, and *prunifolia*, owe their existence to such mixtures.

But were it even doubtful whether new plants were ever produced by mixture, we have perhaps a still more important conclusion to

draw from the observations every day made, that great changes have formerly taken place in our globe, and much wreck been made of its vegetable produce.

The plains and secondary mountains, contain within them a large quantity of petrified bones, shells, and animals. In schistus and sand-stone, there are impressions of various plants. These all proclaim the revolutions which our globe has undergone. But how was this powerful catastrophe brought about, or when did it happen? To these questions we want proofs to enable us to return a satisfactory answer, and must be content to confess our ignorance.

Meanwhile, however, naturalists have not been idle. They have carefully collected the remarkable symbols of former times, and compared them with the organic productions of the present. At first they expected to find many of these again; but they were unable to explain how it was possible for the elephant, the rhinoceros, and hippopotamus to live and prosper in our climates, and in the cold of Siberia; or how palms and various filices could inhabit our northern regions. They endeavoured by many an ingenious hypothesis to account for this; but some of these were contradicted by the discovery of new petrifactions, and others had so little probability, that they went counter to all the known laws of nature.

Enquirers, however, were at last convinced, by many observations, that the petrified remains of animals, as well as the impressions of plants, belonged to subjects not now to be found alive on our globe.

Cuvier possesses a number of the remains of quadrupeds which do not now exist. By conchology we learn that those bivalve shells, which are found in a petrified state, are never to be met with recent: and the beautiful filices we see in schistus, the trunks of trees which are changed into coal, or petrified wood, even in the frigid zones, where cold suffers no tree to grow, are now no where to be found in a living state.

Accordingly, the most celebrated naturalists, as Blumenbach, Batsch, Lichtenberg, and Cuvier, with many others, have drawn this highly probable conclusion, that at least one creation has been lost, and that the present organic world is a new formation.

They leave to the Natural Philosopher and Astronomer to account for these stupendous phænomena; but they believe that, perhaps the brilliant nimbus of the sun, by whose benign influence we

are so much indebted, may at long intervals be increased or diminished, nay, in certain periodical and stated times, be entirely extinguished, and that then, as at first, by the returning splendour of the sun, acting on the ruins of the former creation, and the fermentation of the elements, another new one may arise. The periodical brightness and faintness of the light of some of the fixed stars, and the total disappearance of some of them which once shone with great splendour, seem to confirm the above opinion.

But though these remains of pristine animals and plants have been preserved to our times, still it is certain that their originals are not now to be found; and that our chronology is not sufficient to ascertain the period when changes so eventful have taken place.

With respect to the plants at present existing on our globe, experience shews that mountainous places are richer in vegetables than plains, and that where there are primitive mountains, the number of plants is more considerable than on secondary mountains. A country where there are primitive mountains, has peculiar plants, which are wanting where there are no such mountains. We find upon all plains in the same latitude, however extensive they may be, the same plants without any other difference, than what arises from the difference of soils. Upon the primary mountains, and at their feet, we meet again with all the plants of the plains. We find where high chains of the primary mountains skirt the plains, that all the plants of the plain are found at the bottom, and even up their sides. If we pass over the mountain, and come to a new plain, another vegetation appears, which we again find at the feet of the succeeding chain. From the enumeration of plants made in different countries of Europe, and of other regions, we find this abundantly proved. Who then can doubt the plants of all vallies have been derived from high mountains, and that the primary ones of our globe are the source of the Floras of every different country? Hence it is that America abounds so much in plants, being intersected from the North to the South Pole, by high chains of mountains, with their numerous branches. Hence Canada produces other plants than Pennsylvania, this others than Virginia, this again others than Carolina, and Carolina others than Florida, and so forth. Hence it is that the North-west coast of America nourishes very different plants from the North-east coast, the South-west coast different plants from the South-east coast. Islands that are

flat, have all the plants of the neighbouring continent; but if they contain high mountains, they are not unfurnished with the plants that grow on those.

Thus, though according to these observations, no great changes had happened to the plants at present existing, every hypothesis that should maintain the remains of the vegetable kingdom, to be still existing plants, would be destitute of probability.

May not the sea have formerly been more extended over the globe than it is at present? Perhaps the earth consisted at first of a vast watery plain, broken only by chains of high mountains, and the depth of the sea might be smaller. On these mountains existed the vegetation of the present land. The sea might chuse itself a deeper bed, the mountain would decrease, and the firm land by degrees appear, which would gradually be sown with the plants of the mountains and the vallies. Here and there the sea might leave large lakes of salt water, which would gradually dry up, and leave behind the hard rock salt. This bed of salt would, according to circumstances, by the waves of the sea or by high winds, be covered with earth, or with mud convertible into hard stone. The shore of the sea nourishes, as is well known, its own peculiar plants, which flourish in a soil abounding with salt, but perish where there is none. In the neighbourhood of these beds of salt, the shore plants would find sufficient nourishment and increase. Subterraneous springs of fresh water would flow over these salt beds, and being impregnated with the fossil would appear as salt springs. The shore plants would here find plenty of nourishment, and would propagate rapidly. This appears to be the origin of salt springs, and perhaps accounts for the appearance of the shore plants in their neighbourhood. We accordingly find near salt springs in the interior of Continents, the following plants of the sea shore, which are no where else to be met with, viz. Salicornia *herbacea*, Poa *distans*, Plantago *maritima, subulata*, Glaux *maritima*, Samolus *Valerandi*, Aster *Tripolium acris*, and many others.

When in this way, perhaps after a long succession of years, as we suppose, the land was gradually formed, hurricanes, earthquakes, and volcanoes, might again destroy large tracts, and change the form of the land, by which means a number of plants might be destroyed that afterwards might never appear again. We find most plants growing in their native places plentifully, but there are some,

as may be inferred from what is just said, that have never been found but on one particular spot. For instance, Thunberg found on the Table mountain, at the Cape of Good Hope, and in one place only, the Disa *longicornis*, and Serapias *tabularis*, and never afterwards observed them elsewhere. Tournefort gathered from a single rock of the small island Amorgos, in the Archiepelago of the Mediterranean, the Origanum *Tournefortii*. Sibthorp, who made the same journey long after him, found that plant no where except on that very spot.

Countries that are now separated by the ocean, might formerly have been joined, at least the plants they have in common authorize the supposition. In this way might the most northern part of America have been connected with Europe, and New Holland with the Cape of Good Hope; thus too the island of Norfolk might have been joined to New Zealand, &c. For North America produces several of the smaller European plants, and in New Holland grow some of the plants peculiar to the Cape of Good Hope. In like manner New Zealand, which has a Flora quite different from that of the neighbouring continent of New Holland, possesses most of the plants that are found on Norfolk island, particularly the New Zealand flax, Phormium *tenax*. Of this more examples might be produced if we had room for them.

Besides the manner in which we have said it is probable that plants have been dispersed over the globe, there are other circumstances that have contributed to spread some plants to a distance they would not otherwise have reached. Many seeds are furnished with hooked prickles, which take hold of the hair of animals, and are thus transported to a distance. Birds go in search of various seeds, and drop them often many miles off. The seeds of many aquatic plants cling to the feathers of birds that frequent the waters, and quit them when they alight in places far remote.

The seeds of most plants, when perfectly ripe, sink to the bottom in water. If they are contained in a hard shell, they remain a long time fresh. Some feet under-ground, and at the bottom of the sea, some plants will remain a long time in a state fit for vegetation. At these depths no air can reach them and protected from the access of this, they are not destroyed.

It appears too that rivers and seas may transport plants to far distant places. Ripe and fresh seeds from the West Indies are

sometimes thrown on the shores of Norway. Were the climate of that country fit for such plants, cocoa nuts, and other plants of the torrid zone, would be planted and prosper. The seeds of the service tree are carried to remote places by our rivers. Many German plants have been observed on the coasts of Sweden, many Spanish and French on the shores of Britain, many African and Asiatic on the shores of Italy.

The wind carries the seeds that are furnished with down, with wings or membranaceous rims, as also those that have swollen capsules, to places convenient for their germination. By this means too, some plants that have light seeds are scattered in the tract of the prevailing winds, and carried to places they would not otherwise have reached. The wind carries the winged seeds of the birch, (Betula *alba*), to the tops of towers and high rocks, where they germinate. The birch it likewise, by reason of its light seeds, dispersed over northern Asia, whither the heavy acorns of the oak (Quercus *Robur*) cannot follow them.

Many seed-capsules and fruits burst with an elastic force, and scatter their seeds round about, while others are obliged to remain in the places where they are produced, particularly such as ripen under-ground. The pistillum of some plants, after flowering, turns down, and pushes itself into the earth, where the seeds come to perfection. Examples of this are found in Arachis *hypogæa*, Glycine *subterranea*, Trifolium *subterraneum*, Lathyrus *amphicarpos*, Vicia *subterranea*, Cyclamen, &c. Berries, and all succulent fruits, cannot disperse themselves: they fall to the ground, and their soft skins nourish the young plant. Many birds, and other animals, feed on these; they carry them away, and having eaten the succulent part, let the seeds drop, or the seeds pass uninjured through their intestinal canal, and are thus propagated. In this way the Misletoe, (Viscum *album*), is sown by a bird, the Missel-thrush, (Turdus *viscivorus*), and thus also the Juniper, (Juniperis *communis*).

But man himself has done more for the dispersion of plants, than winds, or seas, or rivers, or animals. He whom all nature obeys, who changes the wilderness into fertile fields, who lays waste whole countries, and again restores them, has, in various ways, promoted the dispersion of plants,

The wars which nations wage with one another; the migrations

of different people; the pilgrimages to Palestine; the travels of merchants, and trade itself, have brought to us great numbers of new plants, and have carried our plants to many distant regions. Almost all our garden vegetables have been brought from Italy and the East; and the most of our grains have come to us from the same quarter. By the discovery of America we have received different vegetables, which formerly were unknown to us, but which are now common.

The thorn apple (Datura *Stramonium*), that is now known over almost all Europe, the cold countries of Sweden, Lapland and Russia excepted, as a poisonous plant, was brought to us from the East Indies, and was so generally dispersed, by means of Gypsies, who used the seeds of it medicinally as an emetic and cathartic.

The kidney-bean, (Phaseolus *vulgaris*), the Phaseolus *nanus*, Impatiens *Balsamina*, and the Panicum *miliaceum* (millet) were likewise brought from the East Indies.

Buck-wheat, the most of our grains and pulse, have come to us from the East through Italy.

Apples, Pears, Plums, Cherries (Prunus *avium*), Medlars (Mespilus *germanica*), Cratægus *torminalis*, and the hazel nut, are originally German plants. In warmer countries they are, however, much more delicious. The numerous varieties of these to be found in our gardens we have received from Italy, Greece, and the Levant.

The horse-chesnut, (Æsculus *Hippocastanum*), according to Clusius, came to Europe from the north of Asia in the year 1550. The Crown Imperial, (Fritillaria *imperialis*), we received first from Constantinople, in the year 1570.

After the discovery of America, many plants from that country have been naturalized in this. The potatoe was first described in 1590, by Caspar Bauhin; and Sir Walter Raleigh, in the year 1623, brought it from Virginia to Ireland, whence it has been distributed over the whole of Europe.

The Œnothera *biennis* was first introduced by the French, on account of its esculent root, in 1674; since which time it has grown so common, that it grows wild in almost every country of Europe in hedges and about the villages.

Tobacco (Nicotiana *Tabacum*), was first described by Conrad

Gesner in 1584. In the year 1560 it was brought to Spain, and in 1564, to France, by Nicot, a French ambassador.

Coleworts and other plants of that sort were brought from Greece to Rome, whence they were spread over all Italy, and at length reached us. It would be tedious to trace the migrations of all the cultivated plants at present in use. It is sufficient to mention a few of them.

With the different kinds of corn, likewise, many plants have been introduced, which are now naturalized. Such as, the blue bottle, (Centaurea *Cyanus*), the corn-cockle, (Agrostemma *Githago*), the wild Radish (Raphanus *Raphanistrum*), the common Myagrum (Myagrum *sativum*), and many others. These plants are only found among corn, and are never seen on waste places where there are no corn-fields. In the same way, at the introduction into Italy of Rice (Oryza *sativa*), from the East Indies, many plants have been observed that grow only amidst the rice. This plant was first raised in Italy in 1696.

The Europeans, in establishing colonies in various parts of the world, have carried along with them all our culinary plants. By this means many European vegetables have been introduced into Asia, Africa and America, and where the climate would allow it, have spread themselves over these countries.

Nature is always busy in making one plant take advantage of the protection of another; she likewise provides for the propagation of seeds in various ways. Lichens and mosses are destined for this purpose in cold climates, the rainy season in tropical countries, and storms and changes of weather in the polar regions. In our climate, besides lichens and mosses, there are commonly three tempestuous periods that assist the dispersion of seeds and plants, namely in spring, in the middle of summer, and in autumn. These, besides the important purpose of purifying the atmosphere, have one of great advantage to the vegetable kingdom. In spring they dispose the seeds that have continued through the winter to hang on the stems of plants: in the middle of summer they carry to a distance those that have grown ripe in the spring, and in harvest those that have come to perfection in summer. Moles and dew-worms and earth worms, having perforated the soil and fitted it for the reception of these seeds, a heavy rain forces them into it, and, by the

benign influence of the sun's rays, at the proper period they germinate. It is easy to imagine, that, in this way, many seeds may be brought to places which are not fit for their reception, and thus perish: on this account the wise Author of Nature has provided the annual plants with a much greater number of seeds than would otherwise have been necessary. A single plant of Turkey corn (Zea *Mays*), bears 3000 seeds; the sun-flower (Helianthus *annuus*), 4000; the poppy (Papaver *somniferum*), 32,000, and tobacco (Nicotiana *tabacum*), 40,320; but of so great a number some must necessarily fall on convenient places and be propagated.

Naked rocky places, on which nothing can grow, are, by the winds, covered with the seeds of lichens, that by means of the accustomed showers in harvest and spring are induced to germinate. Here they grow, and the rock is spotted with their coloured frond. In time the winds and weather deposit small dust in the rough interstices of the rock, and even the decaying lichens leave a thin scurf. On this meagre soil the seeds of mosses are accidentally driven, where they germinate. They grow and produce a pleasant green tuft, which, in time, is fit for the reception of the smaller plants. By the rotting of the mosses and small plants, there arises a thin layer of earth, that in course of time increases, and then becomes fit for the growth of various shrubs and trees, till at last, after many years, where formerly there was nothing but naked rocks, the eye of the traveller is gratified with the sight of extensive woods of the most beautiful trees. Such is the process of Nature! Gradual, great, and constantly conducive to general good are her operations. Mosses and lichens improve in a similar manner the dry and barren sands. The plants that grow naturally in such soils have almost all creeping and extensively penetrating roots; or they are succulent, and draw moisture from the atmosphere. By means of these plants the sandy soil is made fit for the reception of mosses and lichens, and afterwards changed into good and fertile earth.

Mosses cover the stems and roots of trees: they have this particular property, that in warm weather they wither, and in wet weather revive again. They readily attract moisture and maintain themselves in the rugged interstices of the bark. From the tree they draw no nourishment; this they receive entirely from the atmosphere. In winter they protect the tree from cold, in wet weather

from corruption, and in dry weather they impart to it their moisture, and they protect the stem and the root from the burning rays of the sun *.

But the use of mosses is greater still. In them plants and trees will grow as well as in the best garden soil. Gleditsch brought many fruit trees to perfection in mosses alone. Some kinds of mosses grow chiefly in wet and marshy places, as the turf moss (Sphagnum *palustre*). Stagnant waters and ponds have their surfaces covered with them, and are afterwards, by the marshy plants that grow there, converted into meadows and fields. According to Tacitus, the whole Hercynian forest was once a marsh, though now, in the places described by him, there are fertile fields and meadows. Aged husbandmen in various districts can remember places where formerly there was nothing but stagnant water, which are now converted into fertile, fields and rich meadows.

The property of mosses to attract moisture occasions their growing most plentifully in wet places. The tops of mountains are covered with a profusion of them, which draw towards them the moisture of the clouds; the clouds thus attracted, and in which the tops of mountains are almost constantly involved, prevent their being able to retain all the moisture, which therefore sinks into the clefts and crevices, whence it proceeds from all sides to the lowest place, and at last appears in the form of a spring. Many small springs unite and form a rivulet, which in its progress swells to the size of a large stream. Thus to the apparently insignificant mosses, are we indebted almost entirely for the mightiest rivers, and to them moreover do we owe the desiccation of extensive swamps, and the fertility of the most unfruitful soils.

The object of nature is not only the maintenance of every plant, but the turning to use even the decaying parts of every vegetable and animal production. The smallest space is destined to be the abode either of a plant, or of an animal. The richest and most barren soil, the dry sand, the naked rock, the highest Alps, the deepest morass, the bottom of rivers, of ponds, and of the ocean, nay, the darkest cavities under-ground, such as mines, produce their peculiar

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* Mosses and lichens are prejudicial only to young trees where the bark is still active; but mosses, when they are very long, may, by retaining a superabundance of moisture, be hurtful even to grown trees.

plants. Putrescent animal substances are attacked by mucors, and small fungi, which accelerate their destruction, and convert them into earth, to afford soil and nourishment to other plants. Thus the leaves, the stems, the wood, and different parts of vegetables become a prey to these destructive fungi, which complete the process of putrefaction. What appears to be nothing but desolation and death, is the theatre of a new world in miniature. Every created thing serves for the good of the whole.

The plants of fresh water are more widely dispersed than those of the land. Water moderates the heat and cold of climates, and hence many European aquatic plants grow also in warm countries. The common duck-meat (Lemna *minor*), grows not only over all Europe and North America, but is found also in Asia. It has been observed in Pennsylvania, Carolina, Siberia, Tartary, Bucharia, China, Cochin-China, and Japan. The bulrush (Typha *latifolia*), grows over Europe, North America, in Jamaica, in Siberia, China, and Bengal. The great number of water-fowl that yearly migrate, by a most wonderful instinct, from a colder country to a warmer, occasions the wider dispersion of aquatic plants. The most of these plants perfect their seeds at the season when the birds are preparing to set out on their journey. The seeds stick to the feathers, they are also sometimes swallowed by the birds, and afterwards passed without injury.

The plants that grow at the bottom of the sea are found in all regions, because the vicissitudes of heat and cold are never felt at the bottom, which is generally every where of the same temperature. The Fucus *natans*, a very common sea-plant, and which goes by the name of sea-tang, or sea-grass, is found as well under the equator as under the poles. As the marine plants are very numerous, many of them are to be found every where, with this difference only, that some require a more concentrated saltness of the water or a moveable bottom. Others grow at different depths, and it is only on such as prefer shallow water that the climate has any influence. In general it is to be remarked, that the heights or hills which are found under the surface of the ocean, are more productive of plants than the deep gulfs and valleys there.

The mountainous or alpine plants are nearly the same on all those chains which had formerly been connected, but are now disjoined, and there are many that are common to different mountainous ridges,

though each of these may again nourish its own proper plants. Nay, the common alpine plants, that is those that are found on the Alps of Europe and Asia, seem to follow the line of perpetual snow, and are met with on the plains in Greenland, Spitzbergen, Lapland, Nova Zembla, northern Siberia, and Kamschatka, while in the warmer regions they keep on the summits of the highest Alps. On the mountains of Siberia, Lapland, Norway, Scotland, and Switzerland, on the Pyrennees, on the Apennine and Carpathian Alps, as well as on the smaller mountainous chains of Germany, as in the Hartz, in Thuringia, in Silesia, and Bohemia, there are many plants that are common. For instance, the dwarf birch, (Betula *nana*), is found on them all, the Siberian, Apennine, and Carpathian Alps excepted. May not this communion of some plants, which can only be dispersed by means of winds, of birds, and other circumstances, be a proof of a former connexion? Tournefort saw at the foot of the mountain Arrarat, the plants of Armenia, higher up those common in France, still higher those of Sweden, and at the top the alpine plants, which are found at the North Pole. Similar observations have been made by other travellers on mount Caucasus.

On the mountains of Jamaica Swartz found no European alpine plants, but many common European mosses, such as Funaria *hydrometrica*, Bryum *serpillifolium*, *caespititium*, Sphagnum *palustre*, Dicranum *glaucum*, and many others. We know that the seeds of mosses are so small as to be invisible to our eyes, and that it requires a high magnifier to enable us to see them. We know too that they swim in the air; may they not, therefore, have been driven thither by the winds, and, finding a convenient climate, have there generated? At least no other way of accounting for their appearance occurs to me.

Perhaps the seeds of some lichens that grow in warm climates, may be brought by the winds to us, and by reason of our unfavourable climate grow, but bear no fruit. This appears to be the case with the Lichen *caperatus*, which is found in the south of Europe, as in Provence, Italy, &c. on the stems of the olive trees, and on the stakes that serve for the support of the vines, and almost never without the fructification; while with us, where it is so common, it never bears any.

But when the two Forsters found on Tierra del Fuego, the Pinguicula *alpina*, Galium *Aparine*, Statice *Armeria*, and Ranunculus

lapponicus, they might well find it difficult to say how these plants arrived at the furthest corner of the world. It may be questioned, therefore, whether the great resemblance that these plants bore to those of Europe, did not mislead our great naturalists, in taking them for the same, as they might have distinguishing characters which, for want of comparing them with the European species, they did not suppose. When Linnæus and other botanists state varieties of a plant to exist in different zones, they are not always to be trusted; for it has often been seen that such varieties had more constant characters than many which by them are made species, and that they did really constitute true species. Why should not Nature, in different degrees of latitude and longitude, have formed species that exceedingly resemble one another?

In all countries there occurs a remarkable circumstance in the history of plants, namely, that some grow gregariously, and some singly; that is, some always grow numerously and close together, while others are scattered and grow quite solitarily. The reason of this singular circumstance appears to lie in the seeds themselves, which are either too heavy for the wind to carry away, or too light, so as to be destroyed by it, or the elasticity of the capsule is not strong enough to throw them to a distance. The root too of some vegetables is creeping, so that many plants of such must always stand together.

The gregarious plants sometimes occupy great tracts of ground. The common heath (Erica *vulgaris*), extends often for many miles. The whortleberry, (Vaccinium *Myrtillus*), the strawberry, (Fragaria *vesca*), some species of Pyrola, various rushes, (Junci) and some trees are of this kind. Solitary plants are the Turritis *glabra*, Anthericum *Liliago*, Lychnis *dioica*, and many others. But when places are very populous, men have made great alterations in this respect, by planting woods, and bringing plants close together that would have stood separate, &c. The difference between gregarious and solitary plants is of consequence to those who generally do not regard it. We give here for instance mosses, which the forester and the economist trouble themselves less about than they ought. Gregarious mosses are the Sphagnum *palustre*, Dicranum *glaucum*, Polytrichum *commune*, and many others. The solitary are, Polytricum *piliferum*, all the species of Phascum, Weissia *paludosa*, &c.

Plants, like animals, are confined to certain latitudes. Many natives of warm countries can, by degrees, accustom themselves to our climate, and even to those that are colder. Under-shrubs are more easily reconciled to a warm than a cold or even a temperate climate. In high latitudes there falls at the beginning of winter a deep snow, that does not melt till the return of spring, after which, no night frosts are to be expected, and the air of which is but a degree of temperature above the freezing point. In temperate climates, it often freezes strongly without snow having previously fallen, and thus the plants are killed. By this means the polar and alpine plants, which in their native places are covered with snow, are frozen with us, where frosts without snow are frequent. It is only those under-shrubs and annual plants of warm countries, which require a longer time for pushing their shoots and flowers than the short summer of a cold climate permits, that cannot here be inured to the open air, and those which require a great degree of heat.

But trees and shrubs seem to be more sensible of cold, because their perennial trunk is raised high above the ground, and thus sooner suffers by the vicissitudes of the weather. Some that are natives of warm climates have become naturalized with us, perhaps because their cellular texture is tougher than that of other plants; but, on the contrary, there are many, that in this respect are unaccommodating, because their organization will endure no great alternation of heat and cold.

But the most useful plants, like the domestic animals, are capable of succeeding in very different climates. If there are some which are confined to certain zones, there are others in those regions where these cannot live, to supply their places. Under the equator and within the tropics in similar situations, our kinds of grain do not prosper: but, instead of them, there are the rice, (Oryza *sativa*), Indian sorn, (Holcus *Sorghum*), and Turkey corn, (Zea *Mays*), which are proper substitutes for our grain. In Iceland and Greenland neither our corn nor that of the tropical regions will grow; but nature has provided for these countries the Elymus *arenarius*, in abundance, which, in case of necessity, may be used as rye.

In no cold climate are there wanting esculent roots and pulse. Of these many grow wild which remain untried, but of which necessity, if we had not received our garden plants from the East,

would have taught us the use. All our kitchen-garden plants are so obedient to the variation of climate, that they have followed the footsteps of men to almost every region.

From what has been said, it may naturally be inferred that, after so many and such various changes as plants are subject to, it cannot but be difficult to ascertain the exact point from which each has originated. We shall, however, endeavour to fix something with regard to those of our part of the world, because with these, particularly in the northern part of it, we are better acquainted than with others. As to Greece, we must pass it over, because, in a botanical point of view, it is almost wholly unknown to us. Its Flora, however, seems to originate in the Sardinian mountains the coasts of Asia and Africa, and the islands of the Archipelago. According to our former position, plants have descended from the highest mountains to the plains, and we here assume five principal Floras for Europe, namely, the Northern, the Helvetian, the Austrian, the Pyrenean, and the Apennine.

The Northern Flora proceeds from the Norwegian, the Swedish and the Lapland Alps. These nourish in common the plants of the high northern latitudes. The mountains of Scotland seem formerly to have been connected with those of Norway, for the same plants grow on both.

The Helvetic Flora takes its origin from the Swiss, the Bavarian and the Tyrolese mountains. The mountains of Dauphiny, and those of Bohemia and Silesia, are only lateral branches of the same chain. All contain a great number of the same plants.

The Austrian Flora originates in the Austrian, the Carinthian and Steyermark Alps. The Carpathian make a part of the same chain.

The Pyrenean Flora arises in the Pyrenees. The mountains of Catalonia, Castile, and Valentia, are parts of them.

The Apennine Flora is derived from the Apennines, and these send off many secondary branches.

The Helvetic Flora takes up the greatest space. The whole of Germany, with exception of the Austrian circles and Moravia, Prussia, Poland, all France, except the southernmost part of it, the Netherlands and Holland, possess this Flora.

The Northern Flora extends over Denmark, Sweden, and Russia, and partly over England.

The Austrian Flora stretches from the circle of Austria over Moravia, the southern part of Poland, Hungary, Moldavia, Wallachia, Bulgaria, Servia, Bosnia, Croatia, Sclavonia, Istria, and Dalmatia.

The Pyrenean Flora occupies all Spain, the islands of Majorca and Minorca; perhaps also Portugal, but here our information fails.

The Apennine Flora extends over the whole of Italy, Sardinia, Corsica, and a part of Sicily.

If we make a Catalogue of the plants of these five different Floras, the local distribution of them will be very remarkable.

It is also easy to imagine that various mixtures of the different Floras must have taken place after the firm land was formed and settled. This is the reason why the south of France, where the Helvetian and Pyrenean Floras mingle, is so rich in plants. In Piedmont the Pyrenean, the Helvetian, and the Apennine Floras meet; and thither also, by means of the sea, are the plants of the north of Africa brought. For the same reason, Great Britain consists partly of the northern, and partly of the Helvetian Flora; and in Cornwall, the most southern point of the kingdom, the plants of the Pyrenean Flora, by means of the oblique position of the Spanish coast, are mixed with the others. Sweden, Denmark, and Russia, have not maintained the northern Flora pure; many plants of the Helvetian have found their way thither. The same may be said of Germany, and particularly of the mark of Brandenburg, where, besides the Helvetic Flora, we have received a part of the northern. From the northern we have certainly acquired the Malaxis *Loselis*, Neottia *repens*, Helonias *borealis*, Vaccinium *Oxycoccos*, Ledom *palustre*, Andromeda *polifolia*, Linnæa *borealis*, and many others. From the Helvetic Flora the following, Chironia *Centaurea*, Euphorbia *Cyparissias*, Cucubalus *Otites*, and the most of our plants.

It is very remarkable, that two such common plants as the Euphorbia *Cyparissias* and Cucubalus *Otites*, should disappear about twenty German miles from Berlin towards the north, and are not again to be met with, though they prosper perfectly well in the northern botanic gardens. Perhaps these plants will in time sow themselves further north, and proceed, by degrees, in the same direction. Who will say that they have not advanced in a greater degree during the last century, that many plants have not also ex,

tended themselves in the same way, and that the Flora of Berlin, has not acquired new species in a course of years?

Plants that increasē much by seed, and at the same time by the root, must be consequently the more widely dispersed; it is not therefore surprising, that several of these are found over all Europe from one end of it to the other. Those plants too that have light seeds, which the wind can easily bear away, are more easily disseminated than those whose seeds are heavy. Some plants therefore of the former description, have travelled from Lapland to the extremest point of Italy, nay, even to the north of Africa.

The northern parts of Asia possess many of the plants of Europe. We see towards the north, the Northern Flora, towards the south, the Austrian, and between these the Helvetian conspicuous. It would seem that the European mountains had been sooner provided with soil, and that this had been late in taking place on the Asiatic mountains, or that very little soil had covered the mountains on the north-west coast of Asia. It is no wonder then if, even to the Uralian and Altaic chains of mountains, the plains on this side have few Asiatic, but many European plants.

North America produces very many of the small European plants, which, for the most part, are those of the Northern Flora. It is therefore probable that at some former period, there had existed a connexion between both the old and new worlds, which in later times has been broken.

In order to form a just idea of our proposition, with respect to the dispersion of the vegetables of our globe, we must travel over all the high primitive Alps, collect the Flora of each particular mountain down to its bottom, and in the neighbouring vallies, but we must not descend into the plains. Were Europe investigated in this manner, we would be able to determine, according to the number of plants found existing there, how the dispersion must have happened, and how the plants of this or that chain of mountains have found their way to the plains.

The sea-shore does not always indicate the Flora of the interior. Upon the coasts we often find plants that have been brought from the neighbouring regions. For this reason Asia, Africa, and America, within the tropics, possess many plants in common, which they have obtained from the shores of the neighbouring countries. But if we travel further into the interior of those parts of the world,

these plants entirely disappear, and each of these portions of the globe exhibits to us its own indigenous productions, which are the more numerous, if many ranges of mountains, with a loose soil, be in the neighbourhood.

At the Cape of Good Hope, we see around a Flora so rich, so peculiar, and so little mixed, because the place itself is a mountainous region. Madagascar possesses a numerous Flora, because that large island is very mountainous, and two quarters of the world, namely, Africa and Asia, between which it lies, communicate to it their various productions. The Bahama islands are indebted for their rich Flora to their own mountains and the neighbouring countries. We there find not only indigenous plants, but the most of those of Carolina and Florida, and very many inhabitants of the West Indies and of the Mexican Gulph.

To find a plant existing as indigenous in all latitudes would be difficult. Such plants as are found widely dispersed, have been planted by the hand of man. The chickweed (Alsine *media*), which Linnæus and others affirm to be found every where, is met with only in those places to which our culinary plants have been conveyed. We do not find it mentioned by the Indian botanists, although it may perhaps grow in India; but in the warmer places of Africa, I doubt much if it would exist.

An extensive range has been assigned to the common Nightshade, (Solanum *nigrum*), and the Strawberry (Fragaria *vesca*). But naturalists have taken similar plants for varieties of the common European species, and have ascribed to those mentioned a much more extensive residence than they really enjoy. The plants of the coasts have been more widely dispersed by Nature, than those of the interior. Yet even among these the Purslane (Portulaca *oleracea*), the Sow-thistle, (Sonchus *oleraceus*), and the Cellery, (Apium *graveolens*), are the only ones that have wandered far: and indeed the two last have never been met with in the warmest regions of the globe.

It may be doubted, however, if among the numberless plants which our earth produces, there may be any of so accommodating an organization as to endure every climate, as in the animal kingdom, man, the dog and hog do, which we know will prosper from the torrid to the frigid zone. [*Wildenow*.

CHAP. IV.

NUTRITIVE PLANTS.

SECTION I.

Introductory Remarks.

UNDER this title we shall only give specimens of such as are most rare, curious, or valuable; this being the direct scope of the present work, and the limit to which we have confined ourselves in every department of it. There is some difficulty, however, in drawing the line; since, such is the peculiar construction of the digestive organs of different kinds and classes of animals, that a plant or part of a plant which is harmless and inactive to one description, proves strongly medicinal to a second, a useful food to a third, and a rank poison to a fourth: thus the tetrao cupido or pinnated grous, the deer, and some species of the elk, draw an excellent nutriment from the leaves of the kalmia latifolia, which are destructive to sheep, black cattle, horses, and man. The bee greedily and with perfect safety extracts its honey, but the comb hereby produced is poisonous to those who eat of it. So the dhanesa or Indian buceros, feeds to excess on the colubrina or nux vomica; the land-crab (*cancer raricola*) on the berries of the hippomane or manchineel tree, and goats on the *conium maculatum* or medicinal hemlock. In the following sections, therefore, we shall take our examples from plants employed as foods, cordials, or aromatics, by the different nations and varieties of mankind: and our readers will readily allow us to introduce it with the following elegant verses of Dr. Darwin.

" Sylphs! who round earth on purple pinions borne,
Attend the radiant chariot of the morn;
Lead the gay hours along the ethereal hight,
And on each dun meridian shower the light;
Sylphs! who from realms of equatorial day
To climes, that shudder in the polar ray,

Engraved by Lester from a drawing by Hopkins

for the Gallery of Nature & Art.

From zone to zone pursue on shifting wing,
The bright perennial journey of the spring;
Bring my rich balms from Mecca's hallow'd glades,
Sweet flowers, that glitter in Arabia's shades;
Fruits, whose fair forms in bright succession glow
Gilding the banks of Arno, or of Po;
Each leaf, whose fragrant steam with ruby lip
Gay China's nymphs from pictur'd vases sip;
Each spicy rind, which sultry India boasts,
Scenting the night-air round her breezy coasts;
Roots, whose bold stems in bleak Siberia blow,
And gem with many a tint the eternal snow;
Barks, whose broad umbrage high in ether waves
O'er Andes' steeps, and hides his golden caves;
—And, where yon oak extends his dusky shoots
Wide o'er the rill, that bubbles from his roots;
Beneath whose arms, protected from the storm,
A turf-built altar rears its rustic form;
Sylphs! with religious hands fresh garlands twine,
And deck with lavish pomp Hygeia's shrine."

[Editor.

SECTION II.

Bread-fruit Tree.

Artocarpus.—Linn.

The systematic name Artocarpus is merely the English name of the plant translated into Greek. Of this plant there are several species; particularly A. incisa, or bread-fruit tree, with cut or indented leaves; and A. integrifolia, or bread-fruit tree, with whole leaves. The latter is called in India joccahee; it has many varieties, and bears fruit like the preceding, but of an inferior kind.

The genuine bread-fruit tree is the artocarpus incisa. Though this tree has been mentioned by many voyagers, particularly by Dampier, by Rumphius, and by Lord Anson, yet very little notice seems to have been taken of it, till the return of Captain Wallis from the South Seas.

Captain Cook, in his Voyage, observes, that this fruit not only

serves as a substitute for bread among the inhabitants of Otaheity, and the neighbouring islands, but also, variously dressed, composes the principal part of their food. It grows on a tree that is about the size of a middling oak; its leaves are frequently a foot and a half long, of an oblong shape, deeply sinuated like those of the fig-tree, which they resemble in colour and consistence, and in the exsuding of a milky juice upon being broken. The fruit is about the size and shape of a new-born child's head, and the surface is reticulated, not much unlike a truffle; it is covered with a thin skin, and has a core about it as big as the handle of a small knife. The eatable part lies between the skin and the core; it is as white as snow, and somewhat of the consistence of new bread: it must be roasted before it is eaten, being first divided into three or four parts; its taste is insipid, with a slight sweetness, somewhat resembling that of the crumb of wheaten bread mixed with a Jerusalem artichoke. This fruit is also cooked in a kind of oven, which renders it soft, and something like a boiled potatoe; not quite so farinaceous as a good one, but more so than those of the middling sort. Of the bread-fruit they also make three dishes, by putting either water or the milk of the cocoa-nut to it, then beating it to a paste with a stone pestle, and afterwards mixing it with ripe plantains, bananas, or the sour paste which they call mahie.

The unripe artocarpus mahie, is likewise made to serve as a succedaneum for ripe bread-fruit before the season is come on. The fruit of the bread-tree is gathered just before it is perfectly ripe, and being laid in heaps, is closely covered with leaves: in this state it undergoes a fermentation, and becomes disagreeably sweet; the core is then taken out entire, which is done by gently pulling out the stalk, and the rest of the fruit is thrown into a hole which is dug for that purpose generally in the houses, and neatly lined on the bottom and sides with grass: the whole is then covered with leaves, and heavy stones laid upon them, in this state it undergoes a second fermentation, and becomes sour, after which it will suffer no change for many months. It is taken out of the hole as it is wanted for use; and being made into balls, it is wrapped up in leaves and baked: after it is dressed, it will keep for five or six weeks. It is eaten both cold and hot; and the natives seldom make a meal without it, though to Europeans the taste is as disagreeable as that of a pickled olive generally is the first time it is eaten.

To procure this principal article of their food, costs these happy people no trouble or labour, except climbing up a tree: the tree which produces it does not indeed grow spontaneously; but if a man plants ten of them in his life time, which he may do in an hour, he will as completely fulfil his duty to his own and future generations, as the native of our less temperate climate can do, by ploughing in the cold of winter, and reaping in the summer's heat, as often as these seasons return: even if, after he has procured bread for his present household, he should convert a surplus into money, and lay it up for his children.

SECTION III.

Fig Tree.

Ficus.—Linn.

The species of plants that range in the sexual system under the genus ficus are very numerous, and amount to nearly sixty. Of these there are three that are peculiarly entitled to our present attention: the Banian or Indian fig, ficus Indica of Linnæus; the Sycamorus, or sycamore of the Scriptures; and the Carica, or common fig.

1. *Banian Tree.*

Ficus Indica.

This is a native of several parts of the East Indies. It has a woody stem, branching to a great height, and prodigious extent, with heart-shaped, entire leaves, ending in acute points. Milton has thus beautifully and correctly described it, as the plant to which Adam advised to have recourse after having eaten the forbidden fruit. Par. Lost, ix. 1099.

> So counselled he; and both together went
> Into the thickest wood: there soon they chose
> The fig-tree; not that kind for fruit renown'd,
> But such as at this day to Indians known
> In Malabar or Decan spreads her arms,
> Branching so broad and long, that in the ground
> The bended twigs take root, and daughters grow

About the mother tree, a pillar'd shade
High over-arch'd, and echoing walks between.
There oft the Indian herdsman, shunning heat,
Shelters in cool, and tends his pasturing herds
At loop-holes cut through thickest shade: those leaves
They gather'd, broad as Amazonian targe,
And, with what skill they had, together sow'd,
To gird their waist.

Indeed the banian-tree, or Indian fig, is perhaps the most beautiful of nature's productions in that genial climate, where she sports with so much profusion and variety. Some of these trees are of amazing size and great extent, as they are continually increasing, and, contrary to most other things in animal and vegetable life, seem to be exempted from decay. Every branch from the main body throws out its own roots; at first, in small tender fibres, several yards from the ground: these continually grow thicker until they reach the surface; and there striking in, they increase to large trunks, and become parent trees, shooting out new branches from the top: these in time suspend their roots, which, swelling into trunks, produce other branches; thus continuing in a state of progression as long as the earth, the first parent of them all, contributes her sustenance. The Hindoos are peculiarly fond of the banian-tree; they look upon it as an emblem of the Deity, from its long duration, its out-stretching arms, and overshadowing beneficence; they almost pay it divine honours, and

"Find a fane in every sacred grove."

Near these trees the most esteemed pagodas are generally erected; under their shade the Brahmins spend their lives in religious solitude; and the natives of all casts and tribes are fond of recreating in the cool recesses, beautiful walks, and lovely vistas of this umbrageous canopy, impervious to the hottest beams of a tropical sun.

A remarkable large tree of this kind grows on an island in the river Nerbedda, ten miles from the city of Baroche, in the province of Guzerat, a flourishing settlement lately in possession of the East India company, but ceded by the government of Bengal, at the treaty of peace concluded with the Mahrattas in 1783, to Mahdajee Scindia, a Mahratta chief. It is distinguished by the name of Cub-

Engraved by Scott, from a Drawing by Glennell.

For the Gallery of Nature & Art.

BANYAN TREE.

Ficus Religiosa. *LIN.*

beer Burr, which was given it in honour of a famous saint. It was once much larger than at present; but high floods have carried away the banks of the island where it grows, and with them such parts of the tree as had thus far extended their roots; yet what remains is about 2000 feet in circumference, measured round the principal stems; the overhanging branches, not yet struck down, cover a much larger space. The chief trunks of this single tree (which in size greatly exceed our English elms and oaks), amount to 350; the smaller stems, forming into stronger supporters, are more than 3000; and every one of these is casting out new branches, and hanging roots, in time to form trunks, and become the parents of a future progeny. Cubbeer Burr is famed throughout Hindostan for its great extent and surpassing beauty: the Indian armies generally encamp around it, and at stated seasons, solemn jatarras, or Hindoo festivals are held there, to which thousands of votaries repair from various parts of the Mogul empire. It is said that 7000 persons find ample room to repose under its shade. The English gentlemen, on their hunting and shooting parties, used to form extensive encampments, and spend weeks together under this delightful pavilion; which is generally filled with green wood-pigeons, doves, peacocks, and a variety of feathered songsters; crowded with families of monkeys performing their antic tricks, and shaded by bats of a large size, many of them measuring upwards of six feet from the extremity of one wing to the other. This tree not only affords shelter, but sustenance, to all its inhabitants, being covered amidst its bright foliage with small figs of a rich scarlet, on which they all regale with as much delight as the lords of creation on their more various and costly fare.

2. *Sycamore of the Scriptures.*

Ficus Sycamorus.

According to Hasselquist, this is a huge tree, the stem being often 50 feet round. The fruit is pierced in a remarkable manner by an insect. There is an opening made in the calyx near the time the fruit ripens, which is occasioned in two different ways: 1. When the squamæ, which cover the calyx, wither and are bent back, which, however, is more common to the carica than the sycamore. 2. A little below the scales, on the side of the flower-cup, there

appears a spot before the fruit is ripe; the fruit in this place is affected with a gangrene, which extends on every side, and frequently occupies a finger's breadth. It withers: the place affected becomes black; the fleshy substance in the middle of the calyx, for the breadth of a quill, is corroded: and the male blossoms, which are nearest to the bare side, appear naked, opening a way for the insect, which makes several furrows in the inside of the fruit, but never touches the stigmata, though it frequently eats the germen. The wounded or gangrenous part is at first covered or shut up by the blossoms; but the whole is, by degrees, opened and enlarged of various sizes in the different fruits; the margin and sides being all gangrenous, black, hard, and turned inwardly. The same gangrenous appearance is also found near the squamæ, after the insect has made a hole in that place. The tree is very common in the plains and fields of Lower Egypt. It buds in the end of March, and the fruit ripens in the beginning of June. It is wounded or cut by the inhabitants at the time it buds; for without this precaution they say it would not bear fruit.

3. *Common Fig-Tree.*

Ficus Carica.

This rises with a long stem branching 15 or 20 feet high, with large palmated or hand-shaped leaves. Of this there a number of varieties; as the common fig, a large oblong, dark purplish-blue fruit, which ripens in August either on standards or walls, and the tree carries a great quantity of fruit. The brown or chesnut fig; a large globular, chesnut-coloured fruit, having a purplish delicious pulp, ripening in July and August. The black Ischia fig: a middle sized, shortish, flat-crowned, blackish fruit, having a bright pulp, ripening in the middle of August. The green Ischia fig; a large, oblong, globular-headed, greenish fruit, slightly stained by the pulp to a reddish brown colour, ripens in the end of August. The brown Ischia fig; a small, pyramidal, brownish-yellow fruit, having a purplish very rich pulp, ripening in August and September. The Malta fig; a small flat-topped brown fruit, ripening in the middle of August or beginning of September. The round brown Naples fig; a globular, middle-sized, light-brown

fruit, and brownish pulp, ripe by the end of August. The long brown Naples fig; a long dark-brown fruit, having a reddish pulp, ripe in September. The great blue fig; a large blue fruit, having a fine red pulp. The black Genoa fig: a large pear-shaped, black-coloured fruit, with a bright red pulp, ripe in August.

The last species is that most frequently cultivated in this country, and the only one which does not require to be kept in a stove. It may be propagated either by suckers arising from the roots, by layers, or by cuttings. The suckers are to be taken off as low down as possible; trim off any ragged part at bottom, leaving the tops entire, especially if for standards, and plant them in nursery lines, at two or three feet distance from each other, or they may at once be planted where they are to remain, observing, that if they are designed for walls or espaliers, they may be headed to six or eight inches in March, the more effectually to force out lateral shoots near the bottom: but if intended for standards, they must not be topped, but trained with a stem, not less than 15 or 18 inches for dwarf standards, a yard for half standards, and four, five, or six, feet for full standards. They must then be suffered to branch out to form a head; observing, that whether against walls, espaliers, or standards, the branches or shoots must never be shortened, unless to procure a necessary supply of wood: for the fruit is always produced on the upper parts of the young shoots; and if these are cut off, no fruit can be expected. The best season for propagating these trees by layers is in autumn; but it may be also done any time from October to March, or April. Choose the young pliable lower shoots from the fruitful branches; lay them in the usual way, covering the bodies of the layers three or four inches deep in the ground, keeping the top entire, and as upright as possible, and they will be rooted, and fit to separate from the parent in autumn: when they may be planted either in the nursery, or where they are to remain, managing them as above directed. The time for propagating by cuttings is either in autumn at the fall of the leaf, or any time in March. Choose well-ripened shoots of the preceding summer, short, and of robust growth, from about 12 to 15 inches long, having an inch or two of the two-years wood at their base, the tops left entire, and plant them six or eight inches deep, in a bed or border of good earth, in rows two feet asunder: and when planted i

autumn it will be eligible to protect their tops in time of hard frost, the first winter, with any kind of small loose litter.

That part of the history of the fig-tree, which for many ages was so enigmatical, namely, the caprification, as it is called, is particularly worthy of attention, not only as a singular phenomenon in itself, but as it has furnished one of the most convincing proofs of the reality of the sexes in plants. In brief it is this: the flowers of the fig-tree are situated within a pulpy receptacle, which we call the fig or fruit; of these receptacles, in the wild fig-tree, some have male flowers only, and others have male and female, both distinct, though placed in the same receptacle. In the cultivated fig, these are found to contain only female flowers, which are fecundated by means of a kind of gnat bred in the fruit of the wild fig-trees, which pierces that of the cultivated, in order to deposit its eggs within; at the same time diffusing within the receptacle the farina of the male flowers. Without this operation the fruit may ripen, but no effective seeds are produced. Hence the garden fig can only be propagated by layers and cuttings in those countries where the wild fig is not known. The process of thus ripening the fruit, in the Oriental countries, is not left to nature, but is managed with great art, and different degrees of dexterity, so as to reward the skilful husbandman with a much larger increase of fruit than would otherwise be produced. A tree of the same size which in Provence, where caprification is not practised, may produce about 25 pounds of fruit, will by that art, in the Grecian islands, bring ten times that quantity.

Figs are a considerable article in the materia medica, chiefly employed in emollient cataplasms and pectoral decoctions. The best are those which come from Turkey. Many are also brought from the south of France, where they prepare them in the following manner. The fruit is first dipped in scalding-hot ley made of the ashes of the fig-tree, and then dried in the sun. Hence these figs stick to the hands, and scour them like lixivial salts; and for the same reason they purge gently, without griping. They are moderately nutrimental, grateful to the stomach, and easier to digest than any other of the sweet fruits. They have been said to produce lice when eaten as a common food; but this seems to be entirely without foundation. The reason of this supposition seems

to be, that in the countries where they grow naturally, they make the principal food of the poor people, who are generally troubled with these vermin. The wood of the sycamore is not subject to rot, and has therefore been used for making coffins in which embalmed bodies are put. Mr. Hasselquist affirms, that he saw in Egypt coffins made of this kind of wood, which had heen preserved sound for 2000 years.

[*Hasselquist. Gregory. Editor.*

SECTION IV.

Baobab, or Calabash.

Adansonia.—LINN.

THIS is found chiefly on the banks of the Senegal, and has so near a resemblance in its enormous extent and valuable properties to the Banian, that we shall only glance at a few of its peculiar properties. It has a trunk of a prodigious size, spreads its branches wide enough to afford protection to a whole village of inhabitants, and is supposed to possess a greater longevity than any other tree whatever, being calculated to require not less than a thousand years before it attains maturity.

We know of but one species, though Isert tells us there are many, the Adansonia digitata, so called from the finger-like divisions of its leaves. It bears a gourd containing a very pleasant sub-acid fruit, which forms a considerable part of the food of the negro-tribes: who like the Indians, with respect to the Banian, observe it with a kind of religious veneration; and watch devotionally for the opening of its flowers at sun-rise. It adorns with its verdant and compressed vaults and arches the top of Cape Verd, which is hence said to take its name; and its hollow trunk sometimes serves for a temple or hall to a numerous assembly of natives. It is not however lofty. The one observed by Golberry was not more than twenty-four feet in height, though thirty-four in diameter, or a hundred and four in circumference. Darwin asserts that it sometimes rises to seventy feet in height, but we know of no instance of such a growth.

[ISERT, *Reise nach Guinea.*—EDITOR.

SECTION V.

Banana-tree.—Plantain-tree.

Musa.—Linn.

The genus Musa includes three known species, M. Paradisiaca, or Plantain-tree; M. Sapientum, or Banana; and M. Troglytarum. The two former bear an excellent food, and are in many other respects peculiarly worthy of attention. The last has a scarlet berry but not eatable.

1. *Plantain-tree.*

Musa Paradisiaca.—Linn.

This is cultivated in all the islands of the West Indies, where the fruit serves the Indians for bread; and some of the white people also prefer it to most other things, especially to the yams and cassada bread. The plant rises with a soft stalk 15 or 20 feet high; the lower part of the stalk is often as large as a man's thigh, diminishing gradually to the top, where the leaves come out on every side: these are often eight feet long, and from two to three broad, with a strong fleshy mid-rib, and a great number of transverse veins running from the mid-rib to the borders. The leaves are thin and tender, so that where they are exposed to the open air, they are generally torn by the wind; for as they are large, the wind has great power against them: these leaves come out from the centre of the stalk, and are rolled up at their first appearance; but when they are advanced above the stalk, they expand and turn backward. As these leaves come up rolled in this manner, their advance upward is so quick, that their growth may almost be discovered by the naked eye; and if a fine line is drawn across level with the top of the leaf, in an hour the leaf will be near an inch above it. When the plant is grown to its full height, the spikes of flowers appear in the centre, which is often near four feet long. The flowers come out in bunches, those in the lower part of the spike being the largest; the others diminish in their size upward. Each of these bunches is covered with a sheath of a fine purple colour, which drops off when the flowers open. The upper part of the spike is made up of male flowers, which are not succeeded by fruit, but fall off with their covers. The fruit or plantain is

about a foot long, and an inch and a half or two inches diameter: it is at first green, but when ripe pale yellow. The skin is tough; and within is a soft pulp of a luscious sweet flavour. The spikes of the fruit are often so large as to weigh upwards of 40lb. The fruit of this sort is generally cut before it is ripe. The green skin is pulled off, and the heart is roasted in a clear fire for a few minutes, and frequently turned: it is then scraped, and served up as bread. Boiled plantains are not so palatable.

This tree is cultivated on a very extensive scale in Jamaica, without the fruit of which, Dr. Wright says, the island would scarce be habitable, as no species of provision could supply their place. Even flour or bread itself would be less agreeable, and less able to support the laborious negro, so as to enable him to do his business, or to keep in health. Plantains also fatten horses, cattle, swine, dogs, fowls, and other domestic animals. The leaves, being smooth and soft, are employed as dressings after blisters. The water from off the trunk is astringent, and employed by some to check diarrhœas. Every other part of the tree is useful in different parts of rural economy. The leaves are used for napkins and table-cloths, and are food for hogs.

2. *Banana Tree.*

Musa Sapientum.—Linn.

This species differs from the preceding in having its stalks marked with dark purple stripes and spots. The fruit is shorter, straighter, and rounder; the pulp is softer, and of a more luscious taste. It is never eaten green; but when ripe it is very agreeable, either eaten raw or fried in slices as fritters; and is relished by all ranks of people in the West Indies. Both these plants were carried to the West Indies from the Canary Islands, whither, it is believed, they had been brought from Guinea, where they grow naturally. They are also cultivated in Egypt, and in most other hot countries, where they grow to perfection in about ten months from their first planting to the ripening of their fruit. When their stalks are cut down, several suckers come up from the roots, which in six or eight months produce fruit; so that by cutting down the stalks at different times, there is a constant succession of fruit all the year. In Europe some of these plants are raised by gentlemen who have hot-houses capacious enough for their reception, in many of which they

have ripened their fruit very well; but as they grow very tall, and their leaves are large, they require more room in the stove than most people are willing to allow them. They are propagated by suckers, which come from the roots of those plants that have fruited; and many times the younger plants, when stinted in growth, also put out suckers. The fruit of this tree is four or five inches long, of the size and shape of a middling cucumber, and of a highly grateful flavour: the leaves are too yards long, and a foot broad in the middle; they join to the top of the body of the tree, and often contain in their cavities a great quantity of water which runs out upon a small incision being made into the tree, at the junction of the leaves. Bananas grow in great bunches, that weigh 12lbs. and upwards. The body of the tree is so porous as not to merit the name of wood; the tree is only perennial by its roots, and dies down to the ground every autumn. When the natives of the West Indies (says Labat) undertake a voyage, they make provision of a paste of banana, which, in case of need, serves them for nourishment and drink: for this purpose they take ripe bananas, and having squeezed them through a fine sieve, form the solid fruit into small loaves, which are dried in the sun or in hot ashes, after being previously wrapped up in the leaves of Indian flowering-reed.

[*Wright. Labat. Wildenow.*

SECTION VI.

Cassava or Cassada, Manioc or Manihoc.

Jatropha.—Linn.

Of this useful genus of plants there are nine species; and of these we shall notice five.

1. *J. Carcas*, or English Physic-nut, with leaves cordate and angular; a knotty shrub growing about ten or twelve feet high. The extremities of the branches are covered with leaves; and the flowers which are of a green herbaceous kind, are set on in an umbel fashion round the extremities of the branches, but especially the main stalks. These are succeeded by as many nuts, whose outward tegument is green and husky, which being peeled off discovers the nut, whose shell is black, and easily cracked; this contains an almond-like kernel, divided into two parts, between which separation lie two milk white thin membranaceous leaves, easily separable from each other. These have not only a bare resemblance of

perfect leaves, but have in particular every part, the stalk, middle rib, and transverse ones, as visible as any leaf whatsoever.

2. The gossypifolia, cotton-leaved jatropha, or belly-ache bush, the leaves of which are quinquepartite, with lobes ovate and entire, and glandular branchy bristles. The stem, which is covered with a light-greyish bark, grows to about three or four feet high, soon dividing into several wide-extended branches. From among these rise several small deep-red pentapetalous flowers, the pistil of each being thick-set at the top with yellow farinaceous dust, which blows off when ripe. These flowers are succeeded by hexagonal husky blackish berries, which, when ripe, open by the heat of the sun, emitting a great many small dark-coloured seeds, which serve as food for some species of the dove.

3. The multifida, or French physic-nut, with leaves many-parted and polished. The flowers of this grow in bunches, umbel fashion, upon the extremities of each large stalk, very much resembling, at their first appearance, a bunch of red coral: these afterwards open into small five-leaved purple flowers, and are succeeded by nuts, which resemble those of the first species.

4. The manihot, or bitter cassada, has palmated leaves; the lobes lanceolate, very entire and polished.

5. The janipha, or sweet cassada, has palmated leaves, with lobes very entire, the intermediate leaves lobed with a sinus on both sides.

6. The elastica, with ternate leaves, elliptic, very entire, hoary underneath, and longly petioled.

The root of bitter cassada has no fibrous or woody filaments in the heart, and neither boils nor roasts soft. The sweet cassada has all the opposite qualities. The bitter, however, may be deprived of its noxious qualities (which reside in the juice) by heat. Cassada bread, therefore, is made of both the bitter and sweet, thus: the roots are washed and scraped clean, then grated into a tub or trough; after this they are put into a hair bag, and strongly pressed with a view to squeeze out the juice, and the meal or farina is dried in a hot stone bason over the fire; it is then made into cakes. It also makes excellent puddings, equal to millett. The scrapings of fresh bitter cassada are successfully applied to ill-disposed ulcers. Cassada roots yield a great quantity of starch, which the Brasilians export in little lumps under the name of tapioca.

According to father Labat, the smallest bits of manioc which have escaped the grater, and the clods which have not passed the sieve, are not useless. They are dried in the stove after the flour is roasted, and then pounded in a mortar to a fine white powder, with which they make soup. It is likewise used for making a kind of thick coarse cassada, which is roasted till almost burnt; of this, fermented with melasses and West India potatoes, they prepare a much esteemed drink or beverage called ouycou. This liquor, the favourite drink of the natives, is sometimes made extremely strong, especially on any great occasion, as a feast: with this they get intoxicated, and remembering their old quarrels, massacre and murder each other. Such of the inhabitants and workmen as have not wine, drink ouycou. It is of a red colour, strong, nourishing, refreshing, and easily inebriates the inhabitants, who soon accustom themselves to it as easily as beer.

[*Linn. Labat. Editor.*

SECTION VII.

Rice.

Oryza.—Linn.

Of this most useful esculent there is but one known species, which is supposed to be a native of Ethiopia, though now propagated in different parts of the four quarters of the globe. It affords many varieties, of which the following are the chief.

α Common rice: cut six or eight months after planting.

β Early rice: ripens and is cut the fourth month after planting.

γ Dry or mountain rice: the paddy of the Hindus; grows in mountains and other dry soils.

δ Clammy rice: with large, glutinous, very white seeds; will grow well in both dry and moist soils.

These plants may be increased by seeds in the early parts of spring. The seeds should be sown in a hot-bed, and when the plants appear, they should be transplanted into pots filled with rich light earth, and placed in pans of water which should be plunged into a hot-bed; and as the water wastes it must be renewed from time to time. The plants must be preserved in a stove all the summer; when towards the end of August they will produce grain,

which will ripen tolerably well, provided the autumn prove favourable.

It is probable, however, that the mountain-rice, which endures a very considerable degree of cold on the tops of the loftiest hills of Hindustan, and grows in the midst of snow, might be naturalized to our own climate.

Rice is the principal food of the inhabitants in all parts of the East; where it is boiled and eaten, either alone or with their meat. Large quantities of it are sent annually into Europe, and it meets with a general esteem for family purposes. The Javanese have a method of making puddings which seems to be unknown here, but which is not difficult to be practised. They take a conical earthen pot which is open at the large end, and perforated all over: this they fill about half full with rice, and putting it into a larger earthen pot of the same shape, filled with boiling water, the rice in the first pot soon swells, and stops the perforations so as to keep out the water; by this method the rice is brought to a firm consistence, and forms a pudding, which is generally eaten with butter, oil, sugar, vinegar, and spices. The Indians eat stewed rice with good success against the bloody flux; and in most inflammatory disorders they cure themselves with only a decoction of it. The spirituous liquor called arrack is made from this grain. Rice grows naturally in moist places: and will not come to perfection, when cultivated, unless the ground be sometimes overflowed, or plentifully watered. The grain is of a grey colour when first reaped; but the growers have a method of whitening it before it is sent to market. The manner of performing this, and beating it out in Egypt, is thus described by Hasselquist. They have hollow iron cylindrical pestels, about an inch diameter, lifted by a wheel worked with oxen. A person sits between the pestles, and as they rise, pushes forward the rice, whilst another winnows and supplies fresh parcels. Thus they continue working until it is entirely free from chaff. Having in this manner cleaned it, they add one-thirtieth part of salt, and rub them both together, by which the grain acquires a whiteness; then it is passed through a sieve, to separate the salt again from it. In the island of Ceylon they have a much more expeditious method of getting out the rice; for in the field where it is reaped they dig a round hole, with a level bottom, about a foot deep, and eight yards diameter, and fill it with bundles of corn. Having laid it properly, the women drive about half a

dozen oxen continually round the pit; and thus they will tread out forty or fifty bushels a day. This is a very ancient method of treading out corn, and is still practised in Africa upon other sorts of grain. [*Pantologia. Hasselquist. Hawksworth.*

SECTION VIII.

Maize, or Indian Corn.

Zea.—Linn.

Of this genus there are two species, the Curagua, a native of Chili, and the Mays or proper Maize, a native of America. It is this last which is chiefly cultivated not only in America but in many parts of Europe, especially in Italy and Germany. There are many varieties, which differ in the colour of the grain, and are frequently raised in our gardens by way of curiosity, whereby the plant is well known. It is the chief bread corn in some of the southern parts of America, but since the introduction of rice into Carolina it is but little used in the northern colonies. It makes a main part too of the food of the poor people in Italy and Germany, into which it has been transplanted since the discovery of America. This is the sort of wheat mentioned in the book of Ruth, where it is said that Boaz treated Ruth with parched ears of corn dipped in vinegar. This method of eating the roasted ears of Turkey wheat is still practised in the East; they gather in the ears when about half ripe, and having scorched them to their minds, eat them with as much satisfaction as we do the best flour bread.

In several parts of South America they parch the ripe corn, never making it into bread, but grinding it between two stones, mix it with water in a calabash, and so eat it. The Indians make a sort of drink from this grain, which they call bici. This liquor is very flatulent and intoxicating, and has nearly the taste of sour small beer: but they do not use it in common, being too indolent to make it often; and therefore it is chiefly kept for the celebration of feasts and weddings, at which times they often get completely drunk with it. The manner of making this powerful beverage is to steep a parcel of corn in a vessel of water, till it grows sour, then the old women, being provided with calabashes for the purpose, chew some grains of the corn in their mouths, and spitting it into the calabashes, empty them, spittle and all, into the sour liquor, having previously drawn off the latter into another vessel. The chewed grain soon

raises a fermentation, and when this ceases, the liquor is let off from the dregs, and set by till wanted.

In some of the islands of the South Sea, the same beverage is obtained by similar means: and here, where each individual is his own lawgiver, it is no uncommon thing for a near relation to excuse a murderer, for a good drunken banquet of bici.

[*Lin. Pantologia.*

SECTION IX.

Sago.

Areca. Sycas.—LINN.

THE nutritive mealy grain which we call *Sago* is obtained from both the above plants, and we shall hence give a brief account of each.

1. *Cycas.*

Sago tree. Bread-tree of the Hottentots.

This genus of plants belongs to the natural order of the palms, and its fruit is a dry plum with a bivalved kernel. The genus has two species as follow:

1. C. circinalis, or proper Sago-tree. This grows spontaneously in the East Indies, and particularly on the coast of Malabar. It runs up with a straight trunk to 40 feet or more, having many circles the whole length, occasioned by the old leaves falling off; for, standing in a circular order round the stem, and embracing it with their base, whenever they drop, they leave the marks of their adhesion behind. The leaves are pinnated, and grow to the length of seven or eight feet. The pinnæ or lobes are long, narrow, entire, of a shining green, all the way of a breadth, lance-shaped at the point, are closely crowded together, and stand at right angles on each side the mid-rib, like the teeth of a comb. The flowers are produced in long bunches at the foot-stalks of the leaves, and are succeeded by oval fruit, about the size of large plums, of a red colour when ripe, and a sweet flavour. Each contains a hard brown nut, inclosing a white meat, which tastes like a chesnut.

This is a valuable tree to the inhabitants of India, as it not only furnishes a considerable part of their constant bread, but also supplies them with a great article of trade. The trunk contains a farinaceous substance, which they extract from it and make into bread

in this manner: they saw the body into small pieces, and after beating them in a mortar, pour water upon the mass; this is left for some hours to settle. When fit, it is strained through a cloth; and the finer particles of the mealy substance running through with the water, the gross ones are left behind and thrown away. After the farinaceous part has sufficiently subsided, the water is poured off, and the meal being properly dried, is occasionally made into cakes and baked. These cakes are said to eat nearly as well as wheaten bread, and are the support of the inhabitants for three or four months in the year.

The same meal more finely pulverized, and reduced into granules, is what is called sago, which is sent into all parts of Europe, and sold in the shops as a great strengthener and restorative. There is a sort of sago made in the West Indies, and sent to Europe, in the same manner as that from the East; but the West India sago is far inferior in quality to the other. It is supposed to be made from the pith of the areca oleracea.

2. The cycas revoluta, or brood boom (or bread-tree) of the Hottentots, a plant discovered by Professor Thunberg. The pith, or medulla, which abounds in the trunk of this little palm, Mr. Sparman informs us, is collected and tied up in dressed calf or sheepskins, and then buried in the earth for the space of several weeks, till it becomes sufficiently mellow and tender to be kneaded up with water into a paste, of which they afterwards make small loaves or cakes, and bake them under the ashes. Other Hottentots, not quite so nice, nor endued with patience enough to wait this tedious method of preparing it, are said to dry and roast the pith or marrow, and afterwards make a kind of frumenty of it.

2. *Areca.*

Fausel-nut.

This genus also belongs to the natural order of the palm. It includes the three following species.

1. A. cathecu, a native of India. It has no branches, but its leaves are very beautiful; they form a round tuft at the top of the trunk, which is as straight as an arrow. It grows to the height of 25 or 35 feet, and is a great ornament in gardens. The shell which contains the fruit is smooth without, but rough and hairy within; in which it pretty much resembles the shell of the cocoa nut. Its size

is equal to that of a pretty large walnut. Its kernel semblance without, and has also the same whitish veins within when cut in two. In the centre of the fruit, when it is soft, is contained a greyish and almost liquid substance, which grows hard in proportion as it ripens. The extract of this nut has been supposed to be the terra japonica of the shops: but according to later observations, the genuine drug seems to be obtained from the mimosa catechu. The fruit when ripe is astringent, but not unpalatable, and the shell is yellowish. Of this fruit there is a prodigious consumption in the East Indies. The chief use that is made use of it is to chew it with the leaves of betel, mixing with it lime made of sea shells.

2. Areca oleracea, or true cabbage palm, is the most beautiful, and perhaps the tallest, of all trees. The trunk is perfectly straight, and marked with rings at the vestiges of the leave-stalks. Near the ground it is about seven feet in circumference; but tapers as it ascends, and attains the height of 170 or 200 feet. The bark is of an ash colour, till within 25 or 30 feet of the extremity of the tree; when it alters at once to a deep sea green, which continues to the top. About five feet from the beginning of the green part upwards, the trunk is surrounded with its numerous branches, in a circular manner; all the lowermost spreading horizontally with great regularity; and the extremes of many of the higher branches bend wavingly downwards, like so many plumes of feathers. These branches, when full grown, are 20 feet long, more or less; and are thickly set on the trunk alternately, rising gradually superior one to another: their broad curved sockets so surround the trunk, that the sight of it, whilst among these, is lost, which again appears among the uppermost branches, and is there enveloped in an upright green conic spire, which beautifully terminates its great height. As there are many thousand leaves upon one tree, every branch bearing many scores upon it, and every leaf being set at a small and equal distance from one another, the beauty of such a regular lofty group of waving foliage, susceptible of motion, by the most gentle gale of wind, is not to be described. The middle rib, in each leaf, is strong and prominent, supporting it on the under side, the upper appearing smooth and shining. The pithy part of the leaf being scraped off, the inside texture appears to be so many longitudinal thread-like filaments. These, being spun in the same manner as they do hemp, or flax, are used in making cordage of every kind.

Upon removing the large leaves, or branches, which surround the top of the trunk, a little way above the beginning of the green bark, what is called the cabbage is discovered lying in many thin, snow white, brittle flakes, in taste resembling an almond, but sweeter. This substance, which cannot be procured without destroying the tree, is boiled, and eaten with mutton by the inhabitants of the West Indies, in the same manner as turnips and cabbage are with us. What is called the cabbage flower, grows from that part of the tree where the ash-coloured trunk joins the green part already described. Its first appearance is a green husky spatha, growing to above 20 inches long, and about four broad. As this husky spatha is opening while thus young, the farinaceous yellow seed in embryo, resembling fine sawdust, is very plentifully dispersed among stringy filaments, which answer the use of apices in other more regular flowers: these filaments being cleared of this dust, are pickled, and esteemed among the best pickles either in the West Indies or in Europe. But if this spatha is not cut down and opened whilst thus young; if it be suffered to continue on the tree, till it grows ripe and bursts; then the inclosed part, which whilst young and tender is fit for pickling, will by that time have acquired an additional hardness, become soon after ligneous, grow bushy, consisting of very small leaves, and in time produce a great number of small oval thin-shelled nuts, about the size of unhusked coffee berries: these, being planted, produce young cabbage trees. The sockets or grooves, formed by the broad part of the footstalks of the branches, are used by the negroes as cradles for their children. On the inner side of the very young footstalks are tender pelicles, which when dried, it is said, make a writing paper. The trunks serve as gutterings; the pith makes a sort of sago; and the nuts yield oil by decoction. In the pith also, after the trees are felled, there breeds a kind of worm or grub, which is eaten and esteemed a great delicacy by the French of Martinico, St. Domingo, and the adjacent islands.

3. Areca oryzæformis. This is a native of Cochin China, Amboina, &c. It is a slender elegant palm, and the fruit is used for chewing with the betel leaf as well as that of the first species.

[*Forrest. Linn. Amen. Academ.*

SECTION X.

Date-palm, or Date-tree *.

Phœnix.—Linn.

This genus affords us two known species: Ph. farinifera, an Indian tree, with pinnate fronds longer than the trunk; and Ph. dactylifera, with pinnate fronds shorter than the trunk, a native of Arabia and Persia. It is the last to which we are to confine our attention in the present place. Its trunk rises to fifty, sixty, and a hundred feet high; is round, upright and studded with protuberances, which are the vestiges of the decayed leaves. From the top issues forth a cluster of leaves or branches eight or nine feet long, extending all round like an umbrella, and bending a little towards the earth. The bottom part produces a number of stalks like those of the middle, but seldom shooting so high as four or five feet. These stalks, says Adanson, diffuse the tree very considerably; so that wherever it naturally grows in forests, it is extremely difficult to open a passage through its prickly leaves. The date-tree was introduced into Jamaica soon after the conquest of the island by the Spaniards. There are, however, but few of them in Jamaica at this time. The fruit is somewhat in the shape of an acorn. It is composed of a thin, light, and glossy membrane, somewhat pellucid and yellowish, which contain a fine, soft, and pulpy fruit, which is firm, sweet, and somewhat vinous to the taste, esculent, and wholesome; and within this is enclosed a solid, tough, and hard kernel, of a pale grey colour on the outside, and finely marbled within like the nutmeg. The best are brought from Tunis; they are also very fine and good in Egypt, and in many parts of the East. Those of Spain and France look well; but are never perfectly ripe, and very subject to decay. Dates have always been esteemed moderately strengthening and astringent.

* The Indian Date-plum is a plant of a different kind, and is the diospyros of Linnæus. It has nine or ten species, of which the two chief are, first, the *lotus*, a native of Africa, much cultivated in Italy and the South of France, and supposed to be the fruit by which Ulysses and his companions were enchanted and forgot their native country. 2d, The persimon or pitchumon-plum, a native of America, cultivated in the nurseries of our own gardens, though rarely so as to bring its fruit to perfection.—Editor.

Though the date-tree grows every where indiscriminately on the northern coasts of Africa, it is not cultivated with care, except beyond mount Atlas; because the heat is not sufficiently powerful along the coasts to bring the fruit to proper maturity. We shall here extract some observations from M. Des Fontaines respecting the manner of cultivating it in Barbary, and on the different uses to which it is applied. All that part of the Zaara, which is near Mount Atlas, and the only part of this vast desert which is inhabited, produces very little corn; the soil being sandy, and burnt up by the sun, is almost entirely unfit for the cultivation of grain, its only productions of that kind being a little barley, maize, and sorgo. The date-tree, however, supplies the deficiency of corn to the inhabitants of these countries, and furnishes them with almost the whole of their subsistence. They have flocks of sheep; but as they are not numerous, they preserve them for the sake of their wool; besides, the flesh of these animals is very unwholesome food in those countries that are excessively warm; and these people, though ignorant, have probably been enabled by experience to know that it was salutary for them to abstain from it. The date-trees are planted without any order, at the distance of 12 feet one from the other, in the neighbourhood of rivulets and streams, which issue from the sand. Forests of them may be seen here and there, some of which are several leagues in circumference. The extent of these plantations depends upon the quantity of water which can be procured to water them, for they require much moisture. All these forests are intermixed with orange, almond, and pomegranate trees, and with vines which twist round the trunk of the date-trees; and the heat is strong enough to ripen the fruit, though they are never exposed to the sun.

It is generally in winter that new plantations of this tree are formed. For this purpose those who cultivate them take shoots of those which produce the best dates, and plant them at a small distance one from the other. At the end of three or four years, these shoots, if they had been properly taken care of, begin to bear fruit: but this fruit is as yet dry, without sweetness, and even without kernels; they never reach the highest degree of perfection of which they are susceptible till they are about 15 or 20 years old.

These plants are, however, producible from the seeds taken out of the fruit, provided they are fresh. They should be sown in pots

filled with light rich earth, and plunged into a moderate hot-bed of tanner's bark, which should be kept in a moderate temperature of heat, and the earth frequently refreshed with water. When the plants are come up to a proper size, they should be each planted in a separate small pot, filled with the same light earth, and plunged into a hot-bed again; observing to refresh them with water, as also to let them have air in proportion to the warmth of the season, and the bed in which they are placed. During the summer time they should remain in the same hot-bed; but in the beginning of August they should have a great share of air to harden them against the approach of winter; for if they are too much forced, they will be so tender as not to be preserved through the winter without much difficulty, especially if you have not the conveniency of a bark-stove to keep them in.

The trees, however, which spring from seed, never produce so good dates as those that are raised from shoots, they being always poor and ill-tasted. It is undoubtedly by force of cultivation, and after several generations, that they acquire a good quality. The date trees which have been originally sown grow rapidly, and we have been assured that they bear fruit in the fourth or fifth year. Care is taken to cut the inferior branches of the date-tree in proportion as they rise; and a piece of the root is always left of some inches in length, which affords the easy means of climbing to the summit. These trees live a long time, according to the account of the Arabs: and in order to prove it, they say that when they have attained to their full growth, no change is observed in them for the space of three generations.

The number of females which are cultivated is much superior to that of the males, because they are much more profitable. The sexual organs of the date-tree grow, as is well known, upon different stalks, and these trees flower in the months of April and May, at which time the Arabs cut the male branches to impregnate the female. For this purpose they make an incision in the trunk of each branch which they wish to produce fruit, and place in it a stalk of male flowers; without this precaution the date-tree would produce only abortive fruit. In some cantons the male branches are only shaken over the female. The practice of impregnating the date-tree in this manner is very ancient. Pliny describes it very

accurately in that part of his work where he treats of the palm-tree.

There is scarcely any part of the date-tree which is not useful. The wood, though of a spungy texture, lasts such a number of years, that the inhabitants of the country say it is incorruptible. They employ it for making beams and instruments of husbandry; it burns slowly, but the coals which result from its combustion are very strong, and produce a great heat.

The Arabs strip the bark and fibrous parts from the young date-trees, and eat the substance, which is in the centre; it is very nourishing, and has a sweet taste: it is known by the name of the marrow of the date-tree. They eat also the leaves, when they are young and tender, with lemon-juice; the old ones are laid out to dry, and are employed for making mats and other works of the same kind, which are much used, and with which they carry on a considerable trade in the interior parts of the country. From the sides of the stumps of the branches which have been left, arise a great number of delicate filaments, of which they make ropes, and which might serve to fabricate cloth.

A white liquor, known by the name of milk, is drawn also from the date-tree. To obtain it, all the branches are cut from the summit of one of these trees, and after several incisions have been made in it, they are covered with leaves, in order that the heat of the sun may not dry it up. The sap drops down into a vessel placed to receive it, at the bottom of a circular groove made below the incisions. The milk of the date-tree has a sweet and agreeable taste when it is new; it is very refreshing, and is even given to sick people to drink, but it generally turns sour at the end of 24 hours. Old trees are chosen for this operation, because the cutting of the branches, and the large quantity of sap which flows from them, greatly exhaust them, and often cause them to decay.

The male flowers of the date-tree are also useful. They are eaten when still tender, mixed up with a little lemon-juice. They are reckoned highly stimulative; the odour which they exhale is probably the cause of this property being ascribed to them. These date-trees are very lucrative to thei nhabitants of the desert. Some of them produce 20 bunches of dates; but care is always taken to lop off a part of them, that those which remain may be-

come larger; 10 or 12 bunches only are left on the most vigorous trees. It is reckoned that a good tree produces, one year with another, about the value of 10 or 12 shillings to the proprietor. A pretty considerable trade is carried on with dates in the interior part of the country, and large quantities of them are exported to France and Italy. The crop is gathered towards the end of November. When the bunches are taken from the tree, they are hung up in some very dry place where they may be sheltered and secure from insects.

Even the stones, though very hard, are not thrown away. They give them to their camels and sheep as food, after they have bruised them or laid them to soften in water.

The date, as well as other trees which are cultivated, exhibits great variety in its fruit, with respect to shape, size, quality, and even colour. They are reckoned to be at least 20 different varieties. Dates are very liable to be pierced by worms, and they soon corrupt in moist or rainy weather.

From what has been said, it may easily be perceived that there is, perhaps, no tree whatever used for so many and so valuable purposes as the date-tree.

[*Linn. Des Fontaines. Editor.*

SECTION XI.

Olive-Tree.

Olea.—LINN.

THIS genus includes seven known species; of which the four following are chiefly worthy of notice.

1. *O. Europea.*

European Olive.

An ever-green tree common to the woods of the south of France, Spain, and Italy, with lanceolate, very entire, grey, ferruginous leaves, downy or silvery underneath: flowers in small axillary branches, small white, with short tubes spreading open at the top; fruit a superior-berried drupe, of an oblong spheroidal form, and of a yellowish green colour, turning black when ripe. This plant affords a great abundance of varieties and subvarieties, differing

chiefly in the shape of the leaf, or the size of the fruit. With a little protection in severe frost, it may be maintained against walls in the neighbourhood of London; and in Devonshire it will grow as a standard in more open situations, and is seldom injured by the frosts: but we have not warmth of climate enough to bring the fruit to perfection.

The olive abroad is easily propagable by shoots; but the best of bearing trees are reared from grafts on the stocks of olives of an inferior kind. Olive-shoots are ingrafted when in flower: the trees are commonly planted in the form of a quincunx, and in rows at a considerable distance from one another. Between the rows vines are usually planted or grain is sown. Like many other fruit-trees, olives bear well only once in every two years. In England the olive is propagated by layers alone.

Olives have an acrid, bitter, and extremely unpleasant taste, though pickling renders them less disagreeable; and fashion, that regulates our food as well as our dress, has so long and so generally proposed them as a luxury, that the unpleasantness of their taste is gradually gotten the better of, and even relished by those who are much accustomed to them. The Lucca olives, which are smaller than the other sorts, have the weakest taste; the Spanish, which are the largest, have the strongest; the Provence, which are of a middle size, are usually most approved.

Olives designed for preservation are gathered before they are ripe. The art of preparing them consists in divesting them of their bitterness, in preserving their green colour, and in impregnating them with a brine of aromatised sea-salt, which very much improves the taste they would otherwise possess. In some parts of Provence, after the olives have lain some time in the brine, they remove them, take out the kernel, and put a caper in its place. These olives are preserved in the purest oil; and when prepared, strongly stimulate the stomach in winter. Ripe olives are eaten without any preparation, excepting a little seasoning of pepper, salt and oil; for they are extremely tart, bitter, and erosive.

The most valuable part of the olive, however, is its oil. The quantity of this depends upon the nature of the soil in which the plant grows, on the kind of olive which is cultivated, on the care taken in gathering and expressing the fruit, and on the separation of the part to be extracted. If the olives be unripe, the oil will be intole-

rably bitter; if over-ripe, it will be unguinous. The kind of trees that yield coarse oil have this property: they are still, however, expressed for the use of lamps and soaperies.

The olives for expression are gathered in November or December. They should be put in hair or woollen bags, and pressed immediately to obtain a pure and fine oil: for inferior purposes they may remain in heaps, and be pressed with less care in the gross. The fruits are first bruised in a round trough, under a mill-stone, rolling perpendicularly over them; and when sufficiently mashed are put into the trough of an olive-press, bearing down upon them by means of a strong screw. By turning the screw all the liquor is pressed out of the olives, and is called virgin-oil; after which hot water being poured upon the remainder in the press, a coarser oil is obtained. Olive-oil will not keep good longer than a year; after which period it becomes rancid.

Oil of olives is largely employed in medicine in the form of balsams, liniments, emollients, and ointments. It is found useful as an antidote against the poison of vipers, and insects of various kinds. The best soap is made of it, mixed with Alicant salt-wort and quick-lime.

2. *O. Capensis.*

Cape Olive.

A shrub, with a straight jointed trunk; leaves ovate, very entire, flat or waved, paler beneath; flowers white, small, in racemes, appearing in June and July.]

2. *O. Americana.*

American-Olive.

A plant with leaves opposite, lanceolate elliptic, very entire, evergreen; racemes narrowed, axillary; all the bractes permanent, connate, small; segments of the corol resolute; male and female flowers on the same plant with hermaphrodites.

4. *O. Fragrans.*

Sweet-scented Olive.

A large tree of Japan; branches obscurely four-cornered; leaves

decussate, lanceolate, serrate; peduncles, lateral, aggregate, one-flowered, very fragrant.

[*Pantologia.*

SECTION XII.

Vine.

Vitis.—Linn.

Of this genus of plants we know twelve species, natives of the East or of America, with the exception of the common vine which is found in all temperate countries. The following are cultivated.

1. V. vinifera. Common vine.
2. V. Indica. Indian vine.
3. V. laciniosa. Parsley-leaved vine.
4. V. arborea. Pepper vine.

The first is of by far the most consequence; and it is characterised by having lobed, sinuate, naked leaves. It has an abundance of varieties, which we have neither space to detail, nor can perceive any utility in attempting to do so. They are alike propagated from layers or cuttings. The former is the method usually practised, but the latter seems much the better. In order to propagate vines by cuttings, such shoots should be chosen as are strong and well-ripened, of the last year's growth; and these should be cut from the old vine, just below the place where they were produced, taking a knot of the two years wood to each, which should be pruned smooth. The upper part of the shoot should then be cut off, so as to leave the cutting about sixteen inches long. These cuttings are to be placed with their lower part in the ground, in a dry place, laying some litter about their roots to prevent them from drying. Here they should remain till the beginning of April, which is the time to plant them. They are then to be taken up and wiped clean, and if very dry, they should stand with their lower parts in water six or eight hours. Then, having prepared the beds for them, they are to be set at about six feet distance from each other, making their heads slant a little towards the wall. The cutting is to be so buried in the ground, that only the uppermost bud be upon a level with the surface; the earth is then to be well closed about the plant, and a little mould heaped up over the eye of the bud, to keep it

from drying. After this no more trouble is necessary than to keep the ground clear from weeds, and to nail up the shoot as it grows, to the wall, rubbing off the side shoots. The Michaelmas following, if the cuttings have produced strong shoots, they should be pruned down to two eyes. In the spring following the ground is carefully to be dug up about the shoots, and the stalks to be earthed up to the first eye. During the summer all the lateral shoots must be rubbed off as they appear, and only the two from the two eyes which were left must be encouraged; these, as they grow, are to be nailed up against the wall; and in the middle of July they should be shortened, by nipping off their tops, and this will greatly strengthen the shoot. At the Michaelmas following these should be pruned, leaving them each three eyes, if strong; but if weakly, only two. The next summer there will be two shoots from each shoot of the last year's wood; but if there should be two from one eye, which is sometimes the case, the weaker is to be rubbed off. At Midsummer the ends of the shoots are to be pinched off as before; all the weak lateral shoots are to be displaced, as in the preceding summer. And the whole management is to be the same. This is all the culture necessary to young vines.

As to the management of grown vines, it is to be observed, that these rarely produce any bearing shoots from wood that is more than one year old; the great care must therefore be always to have plenty of this wood in every part of the tree. The bearing shoots for the following year should be left at the pruning with four eyes each. The under one of these does not bear, and consequently there are only three which do. Many leave more eyes on the shoots, that they may have more fruit, which is the consequence; but then the fruit is much poorer; and this is so well known in the wine countries, that there are laws to direct that no more than such a number of eyes are to be left on each shoot, for the grapes would else be of a poor juice, and destroy the reputation of their wine. Each of the three eyes left will produce two or three bunches; so that each shoot will give six or nine bunches, which is as much as it can bring to any perfection. The shoots must be laid in at about eighteen inches asunder against the wall; for if they are closer, when the side-shoots are produced there will be no room to train them in upon the wall; and the largeness of the leaves of the vine

requires also that the shoots should be at a proportionable distance.

The best season for pruning vines is the end of September, or beginning of October. The cut is always to be made just above the eye, and sloped backwards from it, that if it bleed, the juice may not run upon the bud; and where there is an opportunity of cutting down some young shoots to two eyes, to produce vigorous shoots for the next year's bearing, it should always be done. In May, when the vines are shooting, they should be looked over, and all the shoots from the old wood should be rubbed off, as also the weaker, whenever there are two produced from one eye. During the month of May the branches must be nailed up against the wall as they shoot, and toward the latter end of this month the ends of the bearing branches should be nipped off, which will greatly strengthen the fruit. Those, however, which are to bear the next year should not be stopped before the beginning of July.

The uses to which the fruit of this valuable tree is applied are well known. The vine was introduced by the Romans into BRITAIN, and appears to have very soon become common. Few ancient monasteries were destitute of a vineyard, and all the oldest ruins contain traces of such a plantation. Malmsbury points out the county of Gloucester as excelling every other part of the country, in his time, in the number and richness of its vineyards. In an early period of our history the isle of Ely was expressly denominated the isle of Vines by the Normans. Vineyards are noticed in the Doomsday-book, as also by Bede, as early as the commencement of the eighth century. Wine was paid at this period as a common tithe. The bishop of Ely, shortly after the conquest, appears to have received at least three or four tuns of wine annually as tithes from the vines in his diocese, and in his leases he made frequent reservations of a certain quantity of wine by way of rent. Many of these were little inferior to the French in sweetness.

GAUL was totally without vines in the days of Cæsar; yet not only this province, but the interior of the country, was largely stocked so early as the time of Strabo. In the reign of Vespasian France became famous for her vineyards, and even exported its wines to Italy.

In the age of Lucullus, however, even the Romans themselves

were seldom able to regale themselves with wine. TALY raised but little; and the foreign wines were so expensive that they were rarely produced even at entertainments; and when they were, every guest was only indulged with a single draught. But in the seventh century after the founding of the city, as their conquests augmented the degree of their wealth and enlarged the sphere of their luxury, wines became an object of particular attention. Vaults were now constructed, and gradually became well-stocked, and the wines of the country acquired a considerable character. The Falernian arose immediately into great repute; the fashion for it, however, progressively gave way; others rose into greater favour, and especially that of Florence, towards the close of the above century; and the more westerly parts of Europe were at once subjugated by the arms of Italy, and exhilarated by her wines.

Vine leaves and the tendrils have an astringent taste, and were formerly used in diarrhœas, hæmorrhages, and other disorders requiring refrigerant and styptic medicines. The juice or sap of the vine, called lachryma, has been recommended in calculous disorders; and it is said to be an excellent application to weak eyes and specks of the cornea. The unripe fruit has a harsh, rough, sour taste; its expressed juice, called verjuice, was formerly much esteemed, but is now superseded by the juice of lemons: for external use, however, particularly in bruises and pains, verjuice is still employed, and considered to be a very useful application.

The fruit of some of the varieties in Persia are so large that a single grape is sufficient for a mouthful.

Vines were transplanted to the CAPE OF GOOD HOPE from the Rhine, from Persia, and many other countries, and are so vastly increased, and yield so plentifully, that the Cape Europeans have much more wine than they can drink, and sell a great deal to the ships that touch there.

Constantia, a place visited by all strangers, is a neat Dutch farm, about eight miles from the Cape; remarkable for its fine wines, both red and white, which are much esteemed every where, as well on account of their richness as their scarcity. The grapes of this vineyard, owing to some peculiar property in the soil, are superior to any other in the country. The vintage is in autumn, which is about March and April. The Cape wines, by being kept about two years, acquire the taste of sack; and such as have been kept

six years, sparkle like old hock, and are as racy as the finest Canary.

There is scarce a cottage in all the colonies without a vineyard; and there are few settlers who do not produce from their own vineyards a plentiful provision of wine for themselves and families.

Though the wine of CANARIA, or the CANARY ISLANDS, is good, it hath not such a body as that of Teneriffe, and is therefore less fit for exportation, yet many pipes of it are annually sent to the Spanish West Indies.

"If we were to judge," says Captain Cook, "from the appearance of the country in the neighbourhood of Santa Cruz, it might be concluded that the island of Teneriffe is a barren spot, insufficient to maintain its own inhabitants; however, the ample supplies which we received convinced us that they had enough to spare for visitors." In the month of August, when our navigator touched here, he found grapes, figs, pears, mulberries, and musk melons: and the island produces a variety of other fruit which was not at that time in season. These advantages led Captain Cook to recommend the island of Teneriffe as a more eligible place than Madeira, for ships bound on long voyages to touch at, notwithstanding the superior excellence of the wine at the latter island; but then the difference of price is in proportion, for the best Teneriffe wine sells for twelve pounds a pipe, whilst a pipe of the best Madeira costs considerably more than double that sum. Formerly there was made at Teneriffe a great quantity of Canary sack, which the French call Vin de Malvesia, and we, corruptly after them, Malmsey (from Malvesia, a town in the Morea, famous for such luscious wine). In the last century, and still later, much of this wine was imported into England; but not more than fifty pipes of this sort of wine were made on the island when Mr. Glass was there, and he says the natives gathered the grapes when green, and made a dry, hard wine of them, fit for hot climates. Of this sort forty thousand pipes are annually made, the greatest part of which is either consumed on the island, or made into brandy and sent to the Spanish West Indies. About six thousand pipes were exported every year to North America, while the trade thither was uninterrupted; in return for which the Americans sent corn, the growth of which on the island is not sufficient to maintain its inhabitants. The Teneriffe wine, when about two or three years old, can hardly

be distinguished from Madeira, but after four years of age it becomes so sweet and mellow, that it resembles the wine of Malaga in Spain. This, like all the other Canary islands, abounds with Ochilla weed.

On the east side of the island of Palma good wines are produced, which have a different taste and flavour from those of Teneriffe: the dry wine is small bodied, and of a yellow colour. The malvesia, or sack, is not so luscious or so strong as that of Teneriffe; but on its being about three years old, it obtains the rich flavour of a ripe pine-apple. These wines, however, are very difficult to preserve, especially when exported to cold climates, where they frequently turn sour.

The manner of making wine at MADEIRA is extremely simple. The grapes are put into a square wooden vessel, the dimensions of which are proportioned to the size of the vineyard to which it belongs. The servants then, having taken off their stockings and jackets, get into it, and with their feet, hands, and elbows, press out as much of the juice as they can. The stalks are afterterward collected, and being tied together with a rope, are put under a square piece of wood, which is pressed down upon them by a lever, with a stone tied to the end of it. The inhabitants have made so little improvement in knowledge or art, that they have not, till within the last twenty-five years (from 1787), brought all the fruit of a vineyard to be of one sort, by engrafting their vines. It is observable of the Madeira wines, that they are greatly improved by the heat of the sun; and a pipe of wine which has been carried across the line, when brought to Europe, acquires a considerable value. In the whole island they annually make about twenty-eight thousand pipes, eight thousand of which are drank there, and the rest exported, the greatest part being sent to the West Indies, especially to Barbadoes.

CHIOS, or SCIO, another celebrated vine-country, called by the Turks Sacki Saduci, is one of the most beautiful and pleasant islands in the Archipelago. It is situated near the coast of Natolia, to the north-west of Samos, and to the south of Mytelene, and extends from 38° 8′ to 38° 37′ north latitude. It is thirty-miles in length, and fifteen in breadth.

"The island of Chios, now Scio," says Dr. Chandler, who travelled into Asia Minor, at the expense of the Society of Dilettanti,

"is by Strabo reckoned nine hundred stadia, or one hundred and twelve miles and a half in circuit, and about four hundred stadia, or fifty miles, from the island of Mytelene. The principal mountain, called by the ancients Pelinæus, presents to view a long lofty range of bare rock, reflecting the sun's rays, but toward its base it is well cultivated, and rewards the labours of the husbandman by its rich produce. The slopes are clothed with vines; the groves of lemon, orange and citron trees, regularly planted, at once perfume the air with the odour of their blossoms, and delight the eye with their golden fruit. Myrtles and jessamines are interspersed with cypresses, olive, and palm trees; amidst these the tall minares rise, and white houses glitter, dazzling the beholder." It is, however, a considerable deduction from the happiness which the inhabitants of so delightful a spot might otherwise enjoy, that the island is very subject to earthquakes.

The vineyards of Scio have been ever celebrated. They still form a considerable part of the riches of this island: its wines, so boasted of by the ancients, continue to deserve their reputation; and immortalized by Virgil, still 'taste sweet in song.'—ECL. V.

Ante focum, si frigus erit; si messis, in umbra;
Vina novum fundam calathis Arvisia nectar.

The ritual feast shall overflow with wine,
And Chios richest nectar shall be thine;
On the warm hearth in winter's chilling hour
We'll sacrifice; at summer in a bow'r.

WARTON.

In some parts of the MARK OF BRANDENBURG the inhabitants apply themselves to the cultivation of the vine. Near Potsdam are a great number of vineyards, for the planting of which the Elector Frederick William caused layers to be brought from the best wine countries.

The south side of the county of Hohenlohe, in the circle of FRANCONIA, has vineyards extending several miles.

Vines are much cultivated in ITALY. In autumn the vintage is a time of general festivity, when the common people give themselves up to all manner of licentiousness.

The SPANISH Wines, particularly sack, are eagerly bought up by foreign nations; and the value of the wines and raisins annually exported out of the country, about Malaga alone, amounts to a million and a half of piastres, an imaginary coin of about three shillings and seven-pence value. The wine produced in the kingdom of Old Castile is excellent.

The country round Malaga is covered with vines and the greatest variety of fruit; it yields a very beautiful prospect, both from the land and sea. Their wines, raisins, oranges, lemons, almonds, figs, and other fruit, are well known, from the large quantities imported to England, beside those sent into other parts of Europe; so that the duties paid to the king, are computed to produce annually eight hundred thousand ducats.

The grape which produces the wine of PORTUGAL, is chiefly cultivated near Oporto, and hence is derived the name of Port Wine.

FRANCE produces great abundance and variety of wines, the cultivation of th evine having been attended to in almost all the provinces, and is probably not less regarded since the revolution in that country. Among the several French wines, that of Champagne is most esteemed, it being a good stomachic, racy, and in taste and flavour exquisite, with an agreeable tartness. That of Burgundy, the best of which is produced abont Beaume, has a fine colour, and a pleasant taste. The wines of Angers and Orleans are also delicate, but heady. In Poictou is produced a white wine that resembles Rhenish. The neighbourhood of Bourdeaux, and the lower parts of Gascony, produce excellent wines. Pontac grows in Guienne. Muscadel and Frontignac are the delicious products of Languedoc. Between Valence and St. Valiere, along the banks of the Rhone, is produced a very agreeable, but roughish red wine, that has a taste not unlike that of bilberries; it is named hermitage, and is considered as very wholesome.

Sterne calls the Bourbonnois "the sweetest part of France;" and speaks in raptures of travelling through it "in the hey-day of the vintage, when nature is pouring her abundauce into every one's lap. A journey, through each step of which music beats time to labour, and all her children are rejoicing as they carry in their clusters."

[*Chandler. Hawksworth. Kindersley. Pantologia.*

SECTION XIII.

Sugar.

Sugar is produced, to a certain extent, by almost all vegetables, and from different parts of the plant, but chiefly the stem, root, and flower; and there are many of them in which the quantity is sufficient to enable the grower to collect, concentrate, and purify it for use. Of these the chief are the saccharum officinarum, or sugar-cane; the acer saccharinum, or sugar-maple, and a variety of beta, denominated the red beet-root. Besides these, the inhabitants of New Spain procure sugar from the agave Americana, and others from the asclepias syriaca, and zea mays, or Indian corn. Nor are the inhabitants of high northern latitudes wholly destitute of vegetables which furnish this useful article; for at Kamschatka it is obtained from the heraleum syphondylium, and the fucus saccharinus.

Sugar, when pure, is perfectly transparent; and if crystallized, colourless; but when granular, of a pure glossy white, soluble in water and alcohol, without smell, and with the taste of simple sweetness, totally void of flavour. It melts by heat into a clear, yellowish, tenacious liquid; and when kindled, burns with a strong flame, and a very pungent acid vapour. With the nitric acid it is convertible chiefly into the oxalic acid. It is a most powerful antiseptic, and is one of the most grateful and (when in mixture) one of the most nutritive of all the alimentary substances derived from the vegetable kingdom. Sugar is never found pure, and very rarely in a state approaching to purity; for it is always intimately combined with mucilage and other vegetable principles, to which it largely imparts its peculiar taste.

Cane Sugar.

Saccharum officinarum.—LINN.

The plant from which this useful material is commonly obtained is the saccharum officinarum of Linnæus. It is prepared from the expressed juice boiled with the addition of quick-lime or common vegetable alkali. It may be extracted also from a number of plants, as the maple, birch, wheat corn, beet-root, skirret, parsnips, dried grapes, &c. by digesting in alcohol. The alcohol dissolves the sugar, and leaves the extractive matter untouched, which

falls to the bottom. It may be taken into the stomach in very large quantities, without producing any bad consequences, although proofs are not wanting of its mischievous effects, by relaxing the stomach, and thus inducing disease. It is much used in pharmacy, as it forms the basis of syrups, lozenges, and other preparations. It is very useful as a medicine, to favour the solution or suspension of resins, oils, &c. in water, and is given as a purgative for infants.

Sugar is every where the basis of that which is called sweetness. Its presence is previously necessary, in order to the taking place of vinous fermentation. Its extraction from plants which afford it in the greatest abundance, and its refinement for the common uses of life, in a pure and separate state, are among the most important of the chemical manufactures. The sugar-cane, however, yields sugar in a proportion so much larger than that in which the same matter is to be obtained from any other, that only this cane has been as yet cultivated expressly for the purpose of affording sugar to the extraction of the manufacturer. This cane has been from the most ancient times known in Asia. Of its produce, some small proportion appears to have been, during the greatness of ancient Rome, imported by circuitous channels into Europe. In the progress of the subsequent ages, the plant itself became known in Europe, and was introduced into cultivation. Before the data of the discovery of America, it was no uncommon cultivation in Spain: the Spaniards carried out plants of the sugar-cane to America; but the plant had been, even before, propagated in this hemisphere. They had not long been seated in their new colonial territories before they made sugar a principal article in their agriculture and manufacture. It has continued ever since to be the principal produce of the European colonial territories in the West India isles. It is produced also in very large quantities in the East. The Anglo-Americans extract it from the maple-tree. The cane is a produce of all the South Sea isles of late discovery.

The following is the mode of its manufacture in the West Indies. The plants are cultivated in rows, on fields enriched by such manures as can most easily be procured, and tilled with the plough. They are annually cut. The cuttings are carried to the mill. They are cut into short pieces, and arranged in small bundles. The mill is wrought by water, wind, or cattle. The parts which act on the canes are upright cylinders. Between these the canes are in-

serted, compressed, squeezed till all their juice is obtained from them, and are themselves, sometimes, even reduced to powder. One of these mills, of the best construction, bruises canes to such a quantity as to afford in one day, 10,000 gallons of juice, when wrought with only ten mules. The expressed juice is received into a leaden bed. It is thence conveyed into a vessel called the receiver. The juice is found to consist of eight parts of pure water, one part of sugar, one part of oil and gummy mucilage. From the greener parts of the canes there is apt to be at times derived an acid juice, which tends to bring the whole unseasonably into a state of acid fermentation. Fragments of the ligneous part of the cane, some portions of mud or dirt, which unavoidahly remain on the canes, and a blackish substance called the crust, which coated the canes at the joints, are also apt to enter into contaminating mixture with the juice. From the receiver the juice is conducted along a wooden gutter, lined with lead, to the boiling-house. In the boiling-house it is received into copper pans, or cauldrons, which have the name of clarifiers. Of these clarifiers the number and the capacity must be proportioned to the quantity of canes, and the extent of the sugar plantation on which the work is carried on. Each clarifier has a syphon or cock, by which the liquor is to be drawn off. Each hangs over a separate fire: and this fire must be so confined, that by the drawing of an iron slider, fitted to the chimney, the fire may at any time be put out. In the progress of the operations, the stream of juice from the receiver fills the clarifier with fresh liquor. Lime in powder is added, in order to take up the oxalic acid, and the carbonaceous matters which are mingled with the juice. The lime also in the new salts, into the composition of which it now enters, adds itself to the sugar, as a part of that which is to be retained by the process. The lime is to be used in the proportion of somewhat less than a pint of this substance to every hundred gallons of liquor. When it is in too great quantities, however, it is apt to destroy a part of the pure saccharine matter. Some persons employ alkaline ashes, as preferable to lime, for the purpose of extracting the extraneous matter; but it is highly probable that lime, judiciously used, might answer better than any other substance whatsoever. The liquor is now to be heated almost to ebullition. The heat dissolves the mechanical union, and thus favours the chemical changes in its differens parts. When the proper heat appears, from a rising

scum on the surface of the liquor, to have been produced, the fire is then extinguished by the application of the damper. In this state of the liquor, the greater part of the impurities, being different in specific gravity from the pure saccharine solution, and being also of such a nature as to yield more readily to the chemical action of heat, are brought up to the surface in a scum. After this scum has been sufficiently formed on the cooling liquor, this liquor is carefully drawn off, either by a syphon, which raises a pure stream through the scum, or by a cock drawing the liquor at the bottom from under the scum. The scum in either case sinks down unbroken, as the liquor flows; and is now, by cooling, of such tenacity, as not to bend to any intermixture with the liquor. The liquor drawn, after this purification, from the boiler, is received into a gutter or channel, by which it is conveyed to the grand copper, or evaporating boiler. If made from good canes, and properly clarified, it will now appear almost transparent. In this copper the liquor is heated to actual ebullition. The scum raised to the surface by the boiling is skimmed off as it rises. The ebullition is continued till there be a considerable diminution in the quantity of the liquor. The liquor now appears nearly of the colour of Madeira wine. It is at last transferred into a second and smaller copper. An addition of lime-water is here made, both to dilute the thickening liquor, to detach superabundant acid, and to favour the formation of the sugar. If the liquor be now in its proper state, the scum rises in large bubbles, with very little discolouration. The skimming and the evaporation together produce a considerable diminution in the quantity of the liquor. It is then transferred into another smaller boiler. In this last boiler the evaporation is renewed, and continued till the liquor is brought to that degree of thickness at which it appears fit to be finally cooled. In the cooler, a shallow wooden vessel of considerable length and wideness, commonly of such a size as to contain a hogshead of sugar; the sugar, as it cools, granulates, or runs into an imperfect crystallization, by which it is separated from the melasses, a mixed saccharine matter, too impure to be capable even of this imperfect crystallization. To determine whether the liquor be fit to be taken from the last boiler, to be finally cooled, it is necessary to take out a portion from the boiler, and try separately, whether it does not separate into granulated sugar and melasses. From the cooler, the sugar is removed to the curing house. This is

a spacious airy building. It is provided with a capacious cistern for the reception of melasses, and over the cistern is erected a frame of strong joist-work, unfilled and uncovered. Empty hogsheads, open at the head, bored at the bottom with a few holes, and having a stalk of plantain leaf thrust through each of the holes, while it rises at the same time through the inside of the hogshead, are disposed upon the frames. The mass of saccharine matter from the coolers is put into these hogsheads. The melasses drip into the cistern through the spongy plantain stalks in the holes. Within the space of three weeks the melasses are sufficiently drained off, and the sugar remains dry. By this process it is at last brought into the state of what is called muscovado, or raw sugar. This is the general process in the British West Indies. In this state our West India sugar is imported into Britain. The formation of loaves of white sugar is a subsequent process. In the French West India isles it has long been customary to perform the last part of this train of processes in a manner somewhat different, and which affords the sugar in a state of greater purity. The sugar, when taken from the cooler, is here put, not into hogsheads with holes in the bottom as above, but into conical pots, each of which has at its bottom a hole half an inch in diameter, which is in the commencement of the process stopped with a plug. After remaining some time in the pot, the sugar becomes perfectly cool and fixed. It is then removed out of the hole; the pot is placed over a large jar, and the melasses are suffered to drip away from it. After as much of the melasses as will easily run off has been thus drained away, the surface of the sugar in the jar is covered with a stratum of fine clay, and water is poured upon the clay. The water oozing gently through the pores of the clay pervades the whole mass of sugar, redissolves the melasses still remaining in it, with some parts of the sugar itself, and carrying these off by the holes in the bottom of the pot, renders that which resists the solution much purer than the muscovado sugar made in the English way. The sugar prepared in this manner is called clayed sugar. It is sold for a higher price in the European markets than the muscovado sugar; but there is a loss of sugar in the process by claying, which deters the British planters from adopting this practice so generally as do the French.

The rawsugars are still contaminated and debased by a mixture of acid, carbonaceous matter, oil, and colouring resin. To fre-

them from these is the business of the European sugar-bakers. A new solution; clarification with alkaline substances fitted to attract away the oil, acid, and other contaminating matters; slow evaporation; and a final cooling in suitable moulds; are the processes which at last produce loaves of white sugar.

The melasses being nothing else than a very impure refuse of the sugar from which they drip, are susceptible of being employed in a new ebullition, by which a second quantity of sugar may be obtained from them. The remainder of the melasses is employed to yield rum by distillation.

In rum, alcohol is mixed with oil, water, oxalic acid, and a mixture of empyreumatic matter. The French prepare, from the mixture of melasses with water, a species of wine of good quality. In its preparation, the solution is brought into fermentation, then passed through strainers to purify it, then put in casks; after clearing itself in these, transferred into others, in which it is to be preserved for use. The ratio of these processes is clear and harmonious; they are all directed to purify the sugar from contaminating mixtures, and to reduce it into that state of dryness or crystallization, in which it is susceptible of being the most conveniently preserved for agreeable use. The heat in general acts both mechanically to effect a sufficient dissolution of the aggregation of the parts of the cane juice, and chemically, to produce in it new combinations into which caloric must enter as an ingredient. The first gentle heat is intended chiefly to operate with the mechanical influence, raising to the surface impurities which are more easily removed by skimming than by any other means; a gentle, not a violent heat, is in this instance employed, because a violent heat would produce empyreumatic salts, the production of which is to be carefully avoided. A boiling heat is, in the continuation of the processes, made use of, because, after the first impurities have been skimmed of, contaminating empyreumatic salts are less readily formed, because a boiling heat is necessary to effect a complete development of the saccharine matter, and because the gradual concentration of the sugar is, by such a heat, to be best accomplished. Lime is employed, because it has a stronger affinity than sugar with all the contaminating matters, and particularly, because it attracts into a neutral combination that exces of oxalic acid which is apt to exist in the saccharine solution. Skimming removes the new salts which the most easily as-

sume a solid form. The dripping carries away a mixture of water, oil, earth, sugar, from the crystallized sugar: for, in all our crystallizations, we can never perform the process in the great way, with such nicety as to preserve it free from an equality of proportions that must necessarily occasion a residue. Repeated solution, clarification, evaporation, are requisite to produce pure white sugar from the brown and raw sugars; because the complete purification of this matter from acid and colouring matter is an operation of great difficulty, and not to be finally completed without processes which are longer than can be conveniently performed, at the first upon the sugar plantation.

From vegetables of European growth sugar is not to be easily obtained, unless the process of germination be first produced in them; or unless they have been penetrated by intense frost. Germination, or thorough freezing, develops sugar in all vegetables in which its principles of hydrogen and carbon, with a small proportion of oxygen, exist in any considerable plenty. It is not improbable but that if penetration by a freezing cold could be commanded at pleasure, with sufficient cheapness, it would enable us to obtain saccharine matter in a large proportion, from a variety of substances from which even germination does not yield a sufficient quantity. In the sugar beet, and some other European vegetables, sugar is naturally formed by the functions of vegetation to perfect combination. From these the sugar is obtained by rasping down the vegetable, extracting by water its saccharine juice, evaporating the water charged with the juice to the consistency of syrup, clarifying, purifying, and crystallizing it, just in the same manner as sugar from the cane.

Maple Sugar.

A valuable sugar is extracted in many of the states of North America, from the juice or sap of the sugar-maple. The tree is tapped with an augre, which is introduced about two inches, and a projecting spout is made below it, under which troughs are set to catch the juice. The season for tapping is from February to April, for about six weeks, during which time a moderate-sized tree will yield from twenty to thirty gallons of sap, from which may be made about five or six pounds of pretty good sugar. During the rest of the year the sap will flow from the wound, but in too thin

and watery a state to be used with advantage for making sugar. This evacuation does not appear at all to injure the tree, for the same process may be repeated every year for a great length of time; and the juice is even more saccharine from trees that have been previously wounded than from fresh trees. The juice is clear and pleasant-tasted. It is made into sugar by the farmers in the country, and with a simple apparatus. It is usually clarified with lime and white of egg, or milk, boiled down, grained and clayed in the manner of the cane-juice. Another method occasionally practised is to reduce the quantity of liquid by freezing, when the season will allow of it, which is preferable to entire evaporation, and at the same time cheaper. The common maple sugar is clean to the eye, and very sweet, but possesses a peculiar, though not an unpleasant taste. It may be made into loaf-sugar probably as well as the muscovado, but it is chiefly employed in a half purified state, like the common moist sugars. The maple-juice will also furnish a pleasant wine and a good vinegar. The saccharine quality of the juice appears to be highly improved by a careful cultivation of the tree.

Beet-Root Sugar.

Among the vegetables indigenous to the middle and north of Europe, which are sensibly saccharine, the beet-root seems to exceed them all in the quantity of sugar it contains. The carrot and parsnip have been tried, but the quantity of sugar possessed by these has not repaid the trouble of working them. Marggraf, who first attempted the beet-root, attempted also the skirret-root, and obtained from this last a small proporton of a good grained sugar, equal to muscovado, from which a syrup separated and dropped through when the plug was withdrawn: but the process was tedious, and the proportion not sufficient to justify its introduction into general use.

The most successful manufacturer of sugar from the beet-root, (unless the late attempts in France, with the extent of which, however, we are not much acquainted, should furnish an exception), is M. Achard of Berlin, who pursued the process altogether in the large way, and so satisfactorily, that a reward was bestowed upon him by the Prussian government for his elaborate experiments. It was hoped, indeed, that this process would enable Europe to supply itself with sugar from its own soil, and to be

no longer dependent on the West Indies; it has for many years, however, been relinquished, and hence there can be no doubt that it was not found to answer upon the broad scale.

The plant employed was the white beet, the root of which resembles the parsnip in shape, and is white crossed with bands of red, and has a mild sweetish taste. It is remarkably succulent, and the saccharine quality of the juice seems to be much improved by a careful cultivation in a rich soil. It has long been cultivated in many parts of Germany as a food for cattle.

The following is M. Achard's process. The roots are pulled, cleaned, and stripped of the leaves; and immediately boiled for a short time, till they are so far softened that a straw may be thrust into them. They are then sliced by a machine used in the country for slicing potatoes, and put under a very strong press to extract the juice. The cake which remains in the press still retains enough juice to make it worth while to moisten it with water, and after some hours again to press it; this juice is mixed with the former. Even after this second pressing, the cake may be usefully employed in making a fermented liquor, from which a spirit may be extracted by distillation. The juice is then strained through a flannel, boiled down to two-thirds of its original bulk, again strained through a thick blanket, and then boiled down to half its bulk and strained. It is now of the consistence of a thin syrup, and must be put in shallow pans in a stove-room, heated to about 120° to allow the sugar to crystallize. This begins by the formation of a hard crust on the surface, which must be now and then broken down to hasten the evaporation. After a time there forms on the surface a thick gummy skin, instead of a hard granular crust; when this appears, the syrup is removed from the stove-room, and the whole mass is put into a close linen sack, previously wetted, and strongly but gradually pressed. By this the syrup is forced through the sack, and there remains within a yellow, granular, saccharine mass, resembling muscovado sugar, very sweet and well tasted. From this sugar, of any degree of fineness, may be afterwards obtained by the processes employed in the refining of sugar from the sugar-cane.

Such was M. Achard's process, which has been since repeated by a committee of the French National Institute, with similar results as to the general products, though the quantity yielded was much less than what might be inferred from the price

stated by the inventor as the first cost to the manufacture. According to these subsequent experiments pursued precisely in M. Achard's method, 1152 parts of fresh beet-root yielded 18 parts of raw muscovado, which was brown and ill tasted, and would require successive purifications with the loss of from a third to nearly half its weight, to bring it into the state of fine saleable sugar.

Professor Lampadius of Frieburg has since pursued a series of experiments upon the same material: but he candidly confesses, that in one of them made on a hundred quintals of the root, the sugar obtained sold for somewhat less than the entire cost of the materials and the process; this, however, was in a cold unfavourable year, and did not include the profits to be obtained from all the residues in yielding, by fermentation, an ardent spirit or kind of rum.

Chemical Properties of Sugar.

Pure sugar appears either in a regularly crystallized form, or in shining white crystalline grains: both in candy and in loaf it is very hard and brittle; when rubbed in the dark it is highly luminous.

The earths proper do not seem to have any action whatever on sugar; but the alkaline earths unite with it. When lime is added to a solution of sugar in water, and the mixture boiled for some time, a combination takes place. The liquid still indeed retains its sweet taste; but it has also acquired a bitter and astringent one. A little alcohol added to the solution produced a precipitate in white flakes, which appeared to be a compound of sugar and lime. Sulphuric acid precipitated the lime in the state of sulphat, and restored the original state of the sugar. When the compound of sugar and lime was evaporated to dryness, a semitransparent tenacious syrup remained, which had a rough bitter taste, with a certain degree of sweetness.

The fixed alkalies combine with sugar, and form compounds not unlike that which has been just described. Potass destroys the sweet taste of syrup more completely than lime; but when it is neutralized by sulphuric acid, and the sulphat precipitated by alcohol, the sweet taste is completely restored. When alcohol is agitated with the compound of sugar and potass dissolved in water,

it refuses to unite with it, but swims on the top in a state of purity.

The acids are capable of dissolving sugar, and those which are concentrated decompose it. Sulphuric acid very soon acts upon it; water is formed, and perhaps also acetic acid; while charcoal is evolved in great abundance, and gives the mixture a black colour, and a considerable degree of consistency. The charcoal may be easily separated by dilution and filtration. When heat is applied, the sulphuric acid is rapidly converted into the sulphureous acid.

Nitric acid dissolves it with effervescence, occasioned by the evolution of nitrous gas, and converts it into malic and oxalic acids. 480 grains of sugar, treated with six ounces of nitric acid diluted with its own weight of water, and cautiously heated, separating the crystals as they are formed, yielded 280 grains of oxalic acid; so that 100 parts of sugar yield by this treatment 58 parts of oxalic acid. When liquid oxymuriatic acid is poured upon sugar in powder, it is dissolved, and immediately converted into malic acid; and the oxymuriatic acid is converted into common muriatic acid.

Sugar absorbs muriatic acid gas slowly, and assumes a brown colour and very strong smell. The vegetable acids dissolve it; but seemingly without producing any alteration on it.

The action of the oxides of carbon and azote upon sugar has scarcely been examined.

Sugar is soluble in alcohol, but not in so large a proportion as in water. According to Wenzel, four parts of boiling alcohol dissolve one of sugar. It unites readily with oils, and renders them miscible with water. A moderate quantity of it prevents, or at least retards, the coagulation of milk; but Scheele discovered that a very large quantity of sugar causes milk to coagulate.

The hydrosulphurets, sulphurets, and phosphurets of alkalies, and alkaline earths, seem to have the property of decomposing sugar, and of bringing it to a state not very different from that of gum. Mr. Cruikshank introduced a quantity of syrup into a jar standing over mercury, and then added about an equal quantity of phosphuret of lime. Phosphureted hydrogen gas was immediately extricated. In eight days the syrup was withdrawn: it had lost its sweet taste, and acquired a bitter and astringent one (the taste of phosphuret of

lime.) From this solution the alcohol threw down white flakes, very much resembling those of mucilage separated from water by the same liquid. A little sugar was dissolved in alcohol, and phosphuret of lime added to it. No apparent action took place. The mixture, after standing in the open air for some days, was evaporated, and water added. No gas was disengaged, as the phosphuret had been converted into a phosphat. The liquid being filtered and evaporated, a tenacious substance remained, much resembling gum arabic. Its taste was bitter, with a slight degree of sweetness. It did not seem soluble in alcohol. It burned like gum.

When sugar is distilled in a retort, there comes over a fluid which at first scarcely differs from pure water; soon it is mixed with what was formerly called pyromucous acid, is now known to be a compound of oil and acetic acid; afterwards some empyreumatic oil makes its appearance, and a bulky charcoal remains in the retort. This charcoal very frequently contains lime, because lime is used in refining sugar; but if the sugar, before being submitted to distillation, is dissolved in water, and made to crystallize by evaporation, in a temperature scarcely higher than that of the atmosphere, no lime whatever, nor any thing else, except pure charcoal, will be found in the retort. During the distillation, there comes over a considerable quantity of carbonic acid and carbureted hydrogen gas. Sugar, therefore, is decomposed by the action of heat; and the following compounds are formed from it—water, acetic acid, oil, charcoal, carbonic acid, carbureted hydrogen gas. The quantity of oil in a separate state is inconsiderable; by far the most abundant product is pyromucous acid. Sugar, indeed, is very readily converted into pyromucous acid; for it makes its appearance always whenever syrup is raised to the boiling temperature. Hence the smell of caromel which syrup at that temperature emits. Hence also the reason, that, when we attempt to crystallize syrup, by heat, there always remains behind a quantity of incrystallizable matter, known by the name of melasses; whereas, if the syrup is crystallized, without artificial heat, every particle of sugar may be obtained from it in a crystalline form. Hence we see the importance of properly regulating the fire during the crystallization of the sugar, and the saving that would probably result from conducting the operation at a low heat.

We are indebted to Mr. Cruikshank for the most precise set of

experiments on the decomposition of sugar by heat. 480 grains of pure sugar were introduced into a coated retort, and heated gradually to redness. The products were,

Pyromucous acid, with a drop or two of oil,	-	270 grains
Charcoal - - - -	-	120
Carbureted hydrogen, and carbonic acid gas	-	90
		480

The pyromucous acid required about 75 grains of a solution of potass to saturate it; and when thus neutralized, no ammonia was disengaged. Hence sugar contains no azote, unless we suppose a very minute portion to be present in the pyromucous acid; and even this is not likely. The charcoal burns away without leaving any residue. Hence sugar contains no earth nor fixed alkali. The proportion of the gasseous products was 119 ounce-measures of carbureted hydrogen, and 41 ounce-measures of carbonic acid gas. The carborated hydrogen, according to the experiments of Cruikshank, was composed of five parts carbon and one hydrogen.

These experiments are sufficient to shew us, that sugar is composed entirely of oxygen, carbon and hydrogen. It is of course a vegetable oxide. Lavosier has concluded, from a series of experiments on the vinous fermentation, that these substances enter into the composition of sugar in the following proportion:

64	oxygen
28	carbon
8	hydrogen
100	

But these proportions can only be considered as very distant approximations to the truth.

From the experiments of different chemists, especially of Proust and Gottling, it appears that there are different species of sugar found ready prepared in the vegetable kingdom; distinguished from each other by the figure of their crystals, and other variations in their properties. The species hitherto examined are three in number, namely, common sugar, sugar of grapes, and sugar of beet. As far as is known at present, there is no difference between the sugar of the maple and common grape.

That grapes contain abundance of sugar has been long known. The duc de Bouillon first extracted it from the juice of grapes, and

Proust pointed out the difference between it and common sugar. The juice of grapes, according to him, yielded from 30 to 40 per cent. of this sugar.

It was Marggraf who discovered sugar in the root of the beta vulgaris; but it is to Achard, as we have already observed, that we are indebted for the first attempts to extract it from that plant in a large way. The experiments of this philosopher, of Lampadius, of the committee appointed by the National Institute, and of Goettling, have thrown more light on this interesting subject. The plan of Lampadius differs but little from the rest. He advises to boil the beet-roots (deprived of the heart) till they become so soft as to be easily pierced by a straw. They are then cut into slices, and the juice forced out by pressure. What remains is left for twelve hours in water, and the whole subjected to the press a second time. The liquids thus obtained are filtered through flannel, boiled down to two-thirds, filtered a second time, reduced by boiling to one-third of the original liquid, filtered a third time, and then evaporated to the consistence of syrup. The crystalline crust which forms on the surface is to be broken from time to time, and the spontaneous evaporation continued till the surface becomes covered with a tough coat instead of crystals. The whole is then to be thrown into woollen bags, and the mucilaginous liquid separated from the crystals by pressure.

The sugar obtained by these processes has much the appearance of raw sugar; but it may be refined by the common processes, and brought into the state of common sugar. From the experiments of Goettling, it appears that beet-sugar is distinguished by a certain degree of a nauseous bitter taste; owing, it is supposed, to the presence of a bitter extractive matter, which Lampadius has shown to be one of the constituents of the beet.

The plants containing sugar are very numerous. The following are the chief of those from which it has been actually extracted by chemists.

The sap of the acer saccharinum,
———— betula alba,
———— asclepias syriaca,
———— heraclium sphondilium,
———— cocos nucifera,
———— juglans alba,

The sap of the agave Americana,
——— fucus saccharinus,
——— ficus carica,
The juice of arundo saccharifera,
——— zea mays,
The roots of pastinaca sativa,
——— sium sisarum,
——— beta vulgaris and cicla,
——— daucus carota,
——— apium petroselinum.

Parmentier has also ascertained that the grains of wheat, barley, &c. and all the other similar seeds which are used as food, contain at first a large quantity of sugar, which gradually disappears as they approach to a state of maturity. This is the case also with peas and beans, and all leguminous seeds: and is one reason why the flavour of young peas is so much superior to that of old ones.

Wheat Sugar.

The difficulty of procuring West-Indian sugar on the continent while the whole of its coast was blockaded by the British marine, and the whole of the West India islands were in the possession of the British government, proved a strong stimulus to urge the spirit of chemistry to exert itself to the utmost in examining the quantity of saccharine matter contained in indigenous plants, with a view of determining the practicability of working sugar from them, as also the possibility of obtaining this material by agents purely chemical. Hence, as we have already seen, the buds, the pulps, the stems, and the roots of different plants were all tried in succession, but ultimately to little effect. For although a certain proportion of saccharine matter has been obtainable from most of these organs, and especially from the beet-root, it does not appear to have been in any instance sufficient to repay the expense of the labour. At length, M. Kirchoff of St. Petersburg succeeded in converting a considerable proportion of the starch of wheat into a saccharine matter, and ultimately into a liquid sugar; and the hint having been thrown out, it has been since followed up in France, with no inconsiderable degree of success. The history of this very recent experiment is highly curious as an article of chemistry, and we readily present our readers with the following account of it in the Annales

de Chemie, as abridged by M. Boullon-Lagrange from M. Vogel's more elaborate detail.

No chemist has hitherto been able to form sugar by chemical agents. It is true, that Fourcroy and some others supposed that at some time or other we should perhaps effect the conversion of starch into sugar, as the component parts of these two substances very nearly approach each other.

Starch, says Fourcroy, announces itself as a little less carbonated than gum: we may say, that it comes very near to saccharine matter; and we shall see hereafter, that it appears in fact capable of forming it by a particular alteration of its own substance*.

Under the head gum, the same chemist expresses himself as follows: It is not improbable, that art may effect the conversion of gums into saccharine matter; and it has been several times remarked, that an aqueous solution of gum, through which oxymuriatic gass is passed, acquires a saccharine taste, mixed with a strong bitterness. This view of the subject, at present quite novel, will lead to many researches, and to useful results.

It is even pretended, that several authors say they have effected this transmutation of fecula into saccharine matter; but how is it possible, that they should have succeeded, and been silent on a fact of such importance?

On looking over what has been published by natural philosophers, it appears incontestible, that it was reserved for M. Kirchoff, of the imperial academy of St. Petersburg, to convert starch into gummy matter, and this into saccharine matter.

His discovery, which opens a new career to vegetable analysis, and may lead to interesting results, has induced M. Vogel to pursue these new facts. His first experiments, some particulars of which he has given in the Journal de Physique, differ scarcely in any thing from those of M. Kirchoff, except in his observing, that part of the saccharine matter is formed in the course of two hours boiling, and that the proportion of two hundredths of sulphuric

* According to Messrs. Gay-Lussac and Thenard, starch is composed of

Carbon	43.55
Oxygen	49.68
Hydrogen	6.77
	10.000

acid produces more than that of one hundredth, the quantity mentioned by the chemist of St. Petersburg.

Since that time M. Vogel has followed up his experiments with more care, in order to acquire an intimate knowledge of the saccharine matter, and the mode of its formation.

To remove every idea of the saccharine matter being the result of simple extraction; a matter that, having escaped fermentation, was concealed by the starch; he washed the starch with a stream of cold water, before he made use of it.

When well dried and reduced to powder, he mixed 2 kil. (4lbs. $6\frac{1}{2}$ oz. avoird.) with 8 kil. of Seine water, acidulated with 40 gr. (0.02 of the weight of the starch) of sulphuric acid at 56° (1.631.)

He then boiled the mixture in a silver basin for thirty-six hours. There is no danger of its burning, except during the first hour, when it must be kept constantly stirring with a broad wooden spatula. After that time the mixture grows much more fluid, and requires only to be stirred occasionally.

It is essential to keep up the quantity of water, by adding fresh as it evaporates.

After this boiling, it is to be clarified when cold by means of charcoal and chalk, and the whole of it is to be filtered through flannel.

The liquid having been evaporated nearly to a syrupy consistence, it must be left to cool, that more of the sulphat of lime may fall down; after which the clear liquid is to be decanted off, and the evaporation finished.

The sugar thus obtained with two hundredths of sulphuric acid in a silver basin was much more saccharine, and less high coloured, than that made in a basin of tinned copper.

In general the latter cannot be used for the purpose, the tin being strongly attacked by the long continued boiling. A leaden vessel has been substituted for it with success.

The 2 kil. boiled with two hundredths of sulphuric acid yielded, in several comparative experiments, sometimes a little less, sometimes a little more, than 2 kil. of syrup at 33° of the areometer (1.295); so from a mean of them we may conclude, without any material error, that starch yields its own weight of syrup.

As many substances have a decidedly sweet taste, for instance, sugar of milk, the sweet matter in liquorice, the sweet principle of

Scheele (formed during the action of fat oils on litharge in making plasters), without, however, containing an atom of sugar, M. Vogel thought it necessary to ascertain, in the first place, whether the sweet liquor from starch contained real sugar.

For this purpose he mixed some yeast with 200 gr. (3089 grs.) of syrup of starch in warm water, and put the whole into a phial, communicating with the pneumatic apparatus, by means of a sigmoid tube.

Fermentation soon took place, with a very brisk extrication of carbonic acid gas.

The 200 grains of syrup yielded by the fermentation upwards of 5 lit. (near 6 quarts) of carbonic acid gas; and a notable quantity of alcohol was obtained by distillation.

It is certain, that all syrup of starch contains more or less gum, the quantity of which varies extremely, according to the time of boiling, and the weight of the acid employed.

The most saccharine syrup evaporated slowly in a stove, and dried in tin moulds, afforded a perfectly transparent elastic substance, in every respect similar to the paste of jujubes.

The author has no doubt that apothecaries may avail themselves of the syrup of starch, for all this kind of gummy saccharine medicaments, particularly those that may remain in a soft state; for the syrup of starch, thus reduced to a solid state, attracts moisture from the air.

M. Vogel substituted the fecula of potatoes for starch, and equally obtained a very saccharine gummy syrup.

The gum was separated by boiling the syrup in a close vessel with alcohol at 30° (0.868.)

The matter, on which the alcohol had no action, and which was found in the most perfect syrup to the quantity of two-tenths, was very viscous: Being dried and powdered, it exhibited all the characters of gum arabic, namely, its solubility in cold water, forming a thick mucilage insoluble in alcohol.

The only character that appears to distinguish this matter from gum arabic is its not forming mucous acid with nitric acid.

It has been asserted, however, that the gummy matter precipitated from syrup of starch is a compound of starch, water, and sulphuric acid.

To satisfy himself on this head, M. Vogel poured a small portion

of alcohol into syrup of starch. The precipitate first formed was composed of sulphat of lime and gum. When this was separated, he poured more alcohol into the syrup that had been decanted from it. The second precipitate was gummy matter, unmixed with sulphate: its solution in water was no longer rendered turbid by muriat of barytes.

The author, however, was not content with this experiment; for it might be objected to him, that the sulphuric acid being chemically combined with the gum, would not quit it to unite with the barytes. He dissolved this gum therefore in barytes water evaporated to dryness, and gave the mass a strong red heat in a platina crucible: thus the sulphuric acid should have been set free, and no doubt would have seized on the barytes. Besides, this sulphat would have been decomposed by the carbon of the gum, and converted into a sulphuret: but muriatic acid poured on the calcined matter extricated nothing but carbonic acid gas, and not an atom of sulphuretted hydrogen gas that could be rendered sensible by paper impregnated with acetate of lead.

Besides, the gum distilled on an open fire did not give out any sulphureous acid, or sulphuretted hydrogen gas.

It is not therefore a hydrat of starch combined with sulphuric acid; which affords us a fresh proof that we must take care not to frame hypotheses before we consult experiment.

He made the same trials with the syrup deprived of gum by alcohol, which did not precipitate the muriat of barytes; but he could not discover in it the least trace of combined sulphuric acid.

These experiments could not fail gradually to lead to an examination of the action of acids diluted with water on some other substances. Sugar of milk first drew his attention; and with the greater reason, as this substance becomes more soluble in water, after it has been treated with acid.

M. Vogel boiled 100 gr. (1545 grs.) of sugar of milk with 400 gr. of water, and 2 gr. of sulphuric acid at 56° (1.631), for three hours, adding more water as it evaporated. After having saturated the excess of acid by carbonat of lime, he filtered.

The liquid, though clear, was slightly coloured. Evaporated slowly in a stove, a thick brownish syrup remained, which concreted into a crystalline mass at the expiration of a few days.

This matter resembling soft sugar has a much more saccharine

taste than the concentrated aqueous solution of sugar of milk. From this extremely saccharine taste the author was led to suspect, that a real sugar had been formed, capable of giving rise to the alcoholic fermentation.

In fact, this product mixed with yeast diluted with water was scarcely placed in favourable circumstances for the alcoholic fermentation, before it commenced in a very brisk manner; though sugar of milk never ferments, as is well known to all chemists, and has been recently placed beyond all doubt by the numerous experiments of M. Bucholz.

This fermented liquor yielded a considerable quantity of alcohol. On varying the proportions of sulphuric acid to three, four, and five hundredths, very saccharine crystals, that ran into fermentation with extreme facility, were constantly obtained, particularly with five hundredths of acids.

With two or with four hundredths of nitric acid the sugar of milk could not be converted into a fermentable sugar.

Three grammes (46.3 grs.) of muriatic acid converted the sugar of milk into a very saccharine syrup capable of the alcoholic fermentation; while 2 gr. (30.89 grs.) of radical vinegar made no alteration in the sugar of milk.

All these syrups reduced to the crystalline state differ from sugar of milk, not only in being susceptible of the alcoholic fermentation, but also in being very soluble in alcohol, a property that sugar of milk does not possess. v aporated to dryness by a gentle fire, a white, granular, and extremely saccharine mass is the result.

It remains to explain the manner in which sulphuric acid acts on starch and sugar of milk, to take from them the principle that masks the saccharine substance, or to convert them into fermentable saccharine matters. The subject, it must be confessed, is difficult, and out of our power to give a clear and plausible theory of this metamorphosis; and if we risk some notions on this subject, it will be with much reserve.

Many are disposed to adopt the opinion, that sugar exists ready formed in starch, and that the sulphuric acid only dissolves or destroys the principle that holds it enchained.

It is obvious, that this reasoning is in a considerable degree

vague; and besides, that it is founded on no experiment, direct or indirect. In this hypothesis too we must imagine a compound altogether new, sugar combined with a substance that renders it insoluble in cold water; and sugar has never yet presented us with such a compound.

Others have supposed, that heat alone is capable of effecting this conversion of fecula into saccharine matter; a fact which, if it were confirmed, might throw fresh light on the saccharine fermentation of Fourcroy.

Accordingly, starch has been boiled with water four days in succession, till it became extremely fluid. The filtered liquor was evaporated, and the result was a thick mucilage, very bitter, without the least taste of sugar. The starch remaining on the filter resisted the action of boiling water, and exhibited a very hard horny matter.

It remains to be examined, therefore, whether the sulphuric acid, or the starch itself, be decomposed.

To judge by the letter from Petersburg, the Russian chemists seem to suppose that a decomposition of the sulphuric acid takes place.

To account for these phænomena, we should operate in close vessels. Accordingly, the author we have referred to introduced into a tubulated receiver a hundred grammes of sugar of milk, four of sulphuric acid, and four hundred of water. To the neck of the retort was adapted a tubulated receiver, from which proceeded a sigmoid tube, opening under a jar filled with water.

After boiling for three hours, no gas had come over, except the air contained in the vessels. A piece of blue paper introduced into the neck of the retort was not reddened. The water that had passed into the receiver was without taste, did not redden litmus paper, had no smell of sulphureous acid, and did not precipitate lime-water, muriat of barytes, or acetat of lead; consequently it contained no sulphureous, sulphuric, acetic, or carbonic acid; in short, it was nothing but pure water.

Barytes-water traversed by the bubbles, extricated during the process, was not rendered turbid in the least, and the gas that had passed into the jars was nothing but the air of the vessels.

It is evident, that the sulphuric acid had not undergone the

slightest decomposition: nevertheless, the sugar of milk was decomposed: it had a much more saccharine taste, and after saturation with chalk it fermented very readily with yeast.

It was necessary, therefore, to examine the decomposing action of the sulphuric acid on the substances in question. For this purpose the same experiment was begun afresh in close vessels, with 100 grs. of sugar of milk, 400 grs. of water, and four grains of sulphuric acid. During the process no gas was evolved, as in the preceding experiment.

The liquid was then concentrated in a dish accurately weighed, after having added five grs. of potash to saturate the acid.

The mass thus evaporated to dryness should have weighed 109 grs. in consequence of the 100 grs. of sugar of milk, 4 grs. of sulphuric acid, and 5 grs. of potash employed; but it weighed only 98 grs. consequently there was a loss of 11 grains. This experiment was repeated twice more, and there was still a loss of 9 or 11 grs. giving a mean of 10 grs.

This loss is too great to be ascribed to any error in the weighing, which was conducted with the greatest care.

Hence we may conclude, that this diminution of weight is occasioned by a quantity of water formed at the expense of the sugar of milk; and this with the more reason, as no gas, no acid, and no other volatile substance, was extricated during the boiling.

All these experiments with the sugar of milk were equally repeated with starch, except that a much larger quantity of water was added to prevent it from burning. The results were the same as those obtained with sugar of milk.

Conclusions.—From all that has been said, it follows:

1. That starch and the fecula of potatoes, boiled with water acidulated with sulphuric acid, are converted into a liquid saccharine matter, the quantity of which corresponds with the weight of the starch employed.

2. That this saccharine matter is susceptible of the alcoholic fermentation.

3. That the syrup of starch is composed of gummy matter and saccharine matter in variable proportions.

4. That the syrup evaporated slowly in a stove exhibits an elastic substance, perfectly transparent.

5. That the gummy matter exhibits all the characters of a tree gum, except that of forming mucous acid by means of the nitric.

6. That neither this gum, nor the saccharine matter, holds sulphuric acid in combination.

7. That the heat of boiling water alone is insufficient to convert starch into saccharine matter, as nothing is obtained but a bitter matter, and a horny substance insoluble in boiling water.

8. That sugar of milk treated with two, three, four, or five hundredths of sulphuric acid is converted into confused crystals, which have an extremely saccharine taste, and are susceptible of the alcoholic fermentation.

9. That this saccharine matter does not contain any sulphuric acid in combination.

10. That the muriatic acid effects the same changes in sugar of milk.

11. That neither the nitric nor acetic acid converts sugar of milk into fermentable sugar.

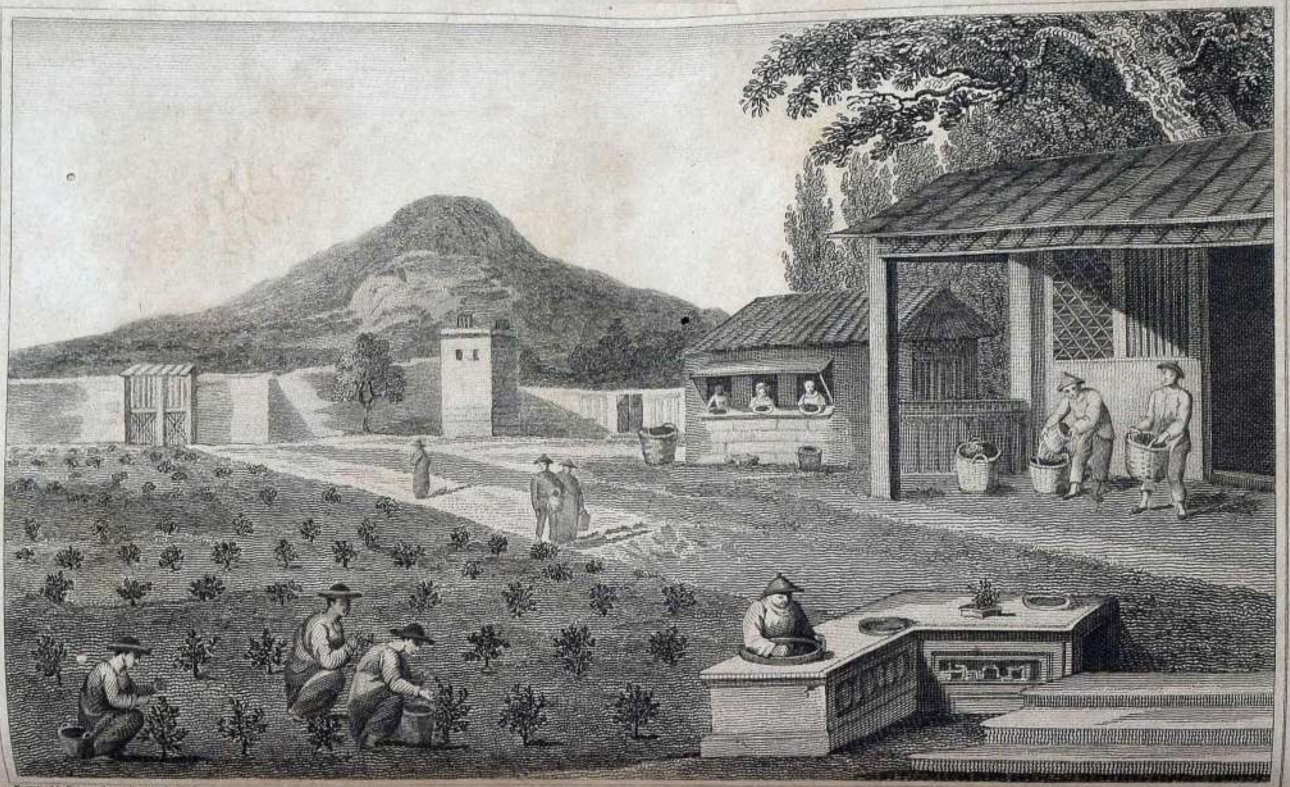
12. That sugar of milk thus converted into fermentable sugar becomes very soluble in alcohol.

13. That sulphuric acid is not decomposed in its action on starch and sugar of milk: and that, from the facts mentioned, it is much more probable, that the acid takes from these substances oxygen and hydrogen in the proportions necessary to form water.

We have only to add, that the preceding experiments have been repeated in our own country with similar results: but that, however curious such results may be as matter of chemical information, neither the quantity nor the quality of the sugar hereby produced can ever render it worth while to persevere in the same process, except in the case of an utter dearth of West-Indian or even East-Indian produce.

Sugar Candy.

This well known material is nothing more than sugar brought to a regular form by slow crystallization. The management of it differs considerably from that of loaf sugar. To prepare it, the syrup is clarified as usual, and boiled down to a certain point, but not so much as for making loaf-sugar. It is then poured into large



TEA TREE.

oblong moulds or boxes, into which a light frame is previously fixed, holding, stretched from one end to the other, a number of cords of packthread. The mould filled with syrup is then put into the drying stove, and suffered to remain undisturbed for a considerable time, during which the sugar gradually deposits itself in crystals around the threads. The mould is then removed, and the frame is lifted out, with every thread thickly and very beautifully encrusted with the candy, and is afterwards drained to free it from the adhering syrup. Sugar-candy is more transparent and much harder than common sugar. The brown sort crystallizes full as regularly as the white, but becomes clammy and deliquescent in a damp air, while the white remains always dry. On account of its superior hardness it is less soluble than the loaf-sugar, and appears to have much less taste, but it has full as strong a body of sugar, and would be excellently calculated for preserving all vegetable food if the price were lower.

[*Pantologia.*

SECTION XIV.

Tea.

Thea.—Linn.

The tea-plant is a native of Japan, China and Tonquin, and has not, as far as we can learn, been found growing spontaneously in any other part of the world *. It is a small ever-green tree, or shrub, much branched, and covered with a bright dark grey bark. Mr. Aiton affirms that it was first introduced into this country in 1768, by John Ellis, Esq. who raised it from seeds and presented it to the king's gardener at Kew: but Dr. Woodville inclines to believe that the tea-plant which first flowered in Europe belonged to his grace the Duke of Northumberland, at Sion House.

Sir Charles Thunberg, one of the most distinguished pupils of Linnæus, who resided sixteen months in Batavia and Japan, has given a full botanical description of the tea plant: and having

* Captain Cook found a low ever-green shrub in great abundance on the island of Teneriffe; which he observes, possesses a great resemblance to the *thea* of Japan and China, and which, though not propagated, and regarded as a weed is used as tea by many of the Spaniards, of the island, who affirm it has the same taste. But we know nothing of the sexual characters of this plant.

Editor.

classed it in the same manner as his master, says expressly that it has only one style. Several of the British botanists, on the other hand, refer it to the order of trigynia; deriving their authority from a plant in the duke of Northumberland's garden at Sion-house, which had three styles.

Linnæus says that there are two species of the tea plant; the bohea, the corolla of which has six petals; and the viridis, or green tea, which has nine petals. Thunberg makes only one species, the bohea, consisting of two varieties: the one with broad and the other with narrow leaves. This botanist's authority is decisive respecting the Japanese tea plants; but as China has not yet been explored, we cannot determine what number of species there are in that country. The tea-tree, however, is now common in the botanical gardens in this country; and it is evident that there are two species, or, at least, permanent varieties of it; one with a much longer leaf than the other, which our gardeners call the green tea; and the other with shorter leaves, which they call the bohea. The green is by much the hardiest plant, and with very little protection will bear the rigour of our winters. Messrs. Loddridges, of Hackney, have now several large plants of it in the open ground, which they only cover with mats in hard frost. It is chiefly propagated in this country by layers.

This plant delights in valleys, and is frequent on the sloping sides of mountains and the banks of rivers, where it enjoys a southern exposure. It flourishes in the northern latitudes of Pekin as well as round Canton; but attains the greatest perfection in the mild temperate regions of Nankin. It is said only to be found between the 30th and 45th degree of north latitude. In Japan it is planted round the borders of fields, without regard to the soil; but as it is an important article of commeree with the Chinese, whole fields are covered with it, and it is by them cultivated with care. The abbé Rochen says, it grows equally well in a poor as in a rich soil; but that there are certain places where it is of a better quality. The tea which grows in rocky ground is superior to that which grows in a light soil; and the worst kind is that which is produced in a clay soil. It is propagated by seeds; from six to twelve are put into a hole about five inches deep, at certain distances from each other. The reason why so many seeds are sown in the same hole is said to be, that only a fifth part vegetate. Being thus sown,

they grow without any other care. Some, however, manure the land, and remove the woods; for the Chinese are as fond of good tea, and take as much pains to procure it of an xcellent equality, as the Europeans do to procure excellent wine.

The leaves are not fit for being plucked till the shrub is of three year's growth. In seven years it rises to a man's height; but as it then bears but few leaves, it is cut down to the stem, and this produces a new crop of fresh shoots the following summer, every one of which bears nearly as many leaves as a whole shrub. Sometimes the plants are not cut down till they are ten years old. We are informed by Kæmpfer, that there are three seasons in which the leaves are collected in the isles of Japan, from which the tea derives different degrees of perfection.

The first gathering commences at the end of February or beginning of March. The leaves are then small, tender, and unfolded, and not above three or four days old: these are called ficki-tsiaa, or "tea in powder," because it is pulverised; it is also called imperial tea, being generally reserved for the court and people of rank; and sometimes also it is named bloom tea. It is sold in China for 20d. or 2s. per pound. The labourers employed in collecting it do not pull the leaves by handfuls, but pick them up one by one, and take every precaution that they may not break them. However long and tedious this labour may appear, they gather from four to ten or fifteen pounds a day.

The second crop is gathered about the end of March or beginning of April. At this season part of the leaves have attained their full growth, and the rest are not above half their size. This difference does not, however, prevent them from being all gathered indiscriminately. They are afterwards picked and assorted into different parcels, according to their age and size. The youngest, which are carefully separated from the rest, are often sold for leaves of the first crops, or for imperial tea. Tea gathered at this season is called too tsiaa, or "Chinese tea," because the people of Japan infuse it, and drink it after the Chinese manner.

The third crop is gathered in the end of May, or in the month of June. The leaves are then very numerous and thick, and have acquired their full growth. This kind of tea, which is called ben-tsiaa, is the coarsest of all, and is reserved for the common people.

Some of the Japanese collect their tea only at two seasons of the

year, which correspond to the second and third already mentioned: others confine themselves to one general gathering of their crop, towards the month of June: however, they always form afterwards different assortments of their leaves.

An infusion of tea is the common drink of the Chinese; and indeed, when we consider one circumstance in their situation, we must acknowledge that Providence has displayed much goodness in scattering this plant with so much profusion in the empire of China. The water is said to be unwholesome and nauseous, and would, therefore, perhaps, without some corrective, be unfit for the purposes of life. The Chinese pour boiling water over their tea, and leave it to infuse, as we do in Europe; but they drink it without any mixture, and even without sugar. The people of Japan reduce theirs to a fine powder, which they dilute with warm water until it has acquired the consistence of thin soup. Their manner of serving tea is as follows: They place before the company the tea-equipage, and the box in which this powder is contained; they fill the cups with warm water, and taking from the box as much powder as the point of a knife can contain, throw it into each of the cups, and stir it until the liquor begins to foam; it is then presented to the company, who sip it while it is warm. According to Du Halde, this method is not peculiar to the Japanese; it is also used in some of the provinces of China.

The first European writer who mentions tea is Giovanni Botero, an eminent Italian author, who published a treatise about the year 1590, of the causes of the magnificence and greatness of cities. He does not indeed mention its name, but describes it in such a manner that it is impossible to mistake it. "The Chinese, (says he) have a herb, out of which they press a delicate juice, which serves them for drink instead of wine; it also preserves their health, and frees them from all those evils which the immoderate use of wine produces among us."

Tea was introduced into Eourope in the year 1610, by the Dutch East India Company. It is generally said, that it was first imported from Holland into England, in 1666, by the lords Arlington and Ossory, who brought it into fashion among people of quality. But it was used in coffee-houses before this period, as appears by an act of parliament made in 1660, in which a duty of 8d. was laid on every gallon of the infusion sold in these places. In 1666 it was

Engraved by Angus, from a Drawing.

sold in London for 60s. per pound, though it did not cost more than 2s. 6d. or 3s. 6d. at Batavia. It continued at this price till 1700. In 1715 green tea began to be used; and as great quantities were then imported, the price was lessened, and the practice of drinking tea descended to the lower ranks. In 1720 the French began to send it to us by a clandestine commerce. Since that period the demand has been increasing yearly, and it has become almost a necessary of life in several parts of Europe, and among the lowest as well as the highest ranks.

The following table will give an idea of the quantity of tea imported annually into Great Britain and Ireland since 1717:

From 1717 to 1726	-	700,000 lbs.
1732 to 1742	-	1,200,000
1755 near	-	4,000,000
1766 -	-	6,000,000
1785 about	-	12,000,000
1794 from		16 to 20,000,000

Besides these immense quantities imported into Britain and Ireland, much has been brought to Europe by other nations. In 1766 the whole tea imported into Europe from China by other nations amounted to 17 millions of pounds; in 1785 it was computed to be about 19 millions of pounds. And during the late war almost the whole of the trade has been in the hands of the English.

In this country teas are generally divided into three kinds of green, and five of bohea: the former are, 1. Imperial or bloom tea, with a large loose leaf, light-green colour, and a faint delicate smell. 2. Hyson, so called from the name of the merchant who first imported it; the leaves of which are closely curled and small, of a green colour, verging to a blue: 3. Singlo tea from the name of the place where it is cultivated. The boheas are, 1. Souchong, which imparts a yellow-green colour by infusion. 2. Cambo, so called from the place where it is made; a fragrant tea, with a violet smell; its infusion pale. 3. Congo, which has a larger leaf than the preceding, and its infusion somewhat deeper, resembling common bohea in the colour of the leaf. 4. Pekoe tea; this is known by the appearance of small white flowers mixed with it. 5. Common bohea, whose leaves are of one colour. There are other varie-

ties, particularly a kind of green tea, done up in roundish balls, called gun-powder tea.

[*Aiton. Woodville. Du Halde. Gregory.*

SECTION XV.

Coffee.

Coffea.—LINN.

THIS genus of plants contains ten species, chiefly natives of the East Indies, South America, and the Polynesian isles. The only species, however, that we here notice in the present work is the Coffea Arabica, of which there are two varieties, though both are sold in our shops as Turkey coffee, and possess similar qualities.

α. With leaves oblong-ovate; flowers in axillary clusters; corols five-cleft.

β. With berries oblong, acute at the base; leaves opposite and waved; flowers from two to four together, nearly sessile, white odorous.

The tree seldom rises more than 16 or 18 feet high, with an erect main stem, covered with a lightish brown bark: the leaves are oblong-ovate, pointed; flowers in axillary clusters, the corols of which are five-cleft. These flowers are of a pure white, and very pleasant odour, but their duration is very transient. The fruit resembles a cherry; and grows in clusters, ranged along the branches under the axillæ of the leaves, which are of a laurel hue, but rather longer than a laurel leaf. It is an ever-green, and makes a beautiful appearance at every season in the stove, but particularly when it is in flower. The coffee-tree is now propagated in great plenty in many parts of America; but the produce of these countries is greatly inferior to that of Arabia. This plant is propagated by seeds, which should be sown soon after they are gathered from the tree, for if kept but a short time out of the ground, they will not grow, which is the chief reason that this tree has not been spread into more different countries; for the seeds will not keep long enough to be sent into any place; so that in order to cultivate this plant in any part of the world, it is absolutely necessary to have it carried thither growing. The berries are commonly ripe with us in April, at which time they should be sown in pots of fresh light

earth, covering them about half an inch thick with the same light earth; then plunge the pots into a moderate hot-bed of tanner's bark, observing to refresh them often with water, as also to raise the glasses in the heat of the day, to admit fresh air; and in very hot weather, it will be proper to shade the glasses with mats, otherwise the earth in the pots will dry too fast, and prevent the vegetation of the seeds. It must be observed, that the taking off the pulp of the berries, which has been by some people directed as absolutely necessary, is a great mistake. When this plant is removed, great care should be taken not to break or injure the roots, and also to preserve the earth to the roots; nor should they be kept any time out of the ground, for if their fibres be suffered to dry, they are very subject to mould, and perish soon after. The soil in which this tree has been observed to thrive best was composed in the following manner, viz. one load of fresh, light, loamy earth; one load of rotten cow-dung, with half a load of sea sand: these were well mixed together, and laid in a heap six months before it was used, in which space it was turned several times, the better to incorporate the several parts.

The coffee-tree has of late years been much cultivated in the islands of America, both by the English and French, but the coffee which has been thence brought to Europe has been very little esteemed. This great difference in the goodness many have attributed to the soil in which it grows, and therefore have supposed it impossible for the inhabitants of the British islands ever to cultivate this commodity to any real advantage; but this is certainly a mistake, as is affirmed by several persons of credit, who have resided in these islands, who say, that the berries which they have gathered from the trees and roasted themselves, were as well flavoured as any of the coffee brought from Mocha; so that the fault is in the drying, and bringing over; for if in the drying of the berries they be laid in rooms near the sugar-works, or near the house where the rum is distilled, the berries will soon imbibe the surrounding effluvia, which will greatly alter their flavour. In like manner the coffee brought in the same ships with rum and sugar, were the coffee ever so good, would hereby be entirely altered.

With respect to the medicinal properties of coffee, it is in general excitant and stimulating; though we doubt whether it relaxes the animal fibres, as has by some authors been supposed. Its more

or less wholesome effect greatly depends on the climate, as well as the age, constitution, and other peculiarities, of the individual. Hence it cannot be recommended to children, or persons of a hot, choleric, nervous, or phthisical habit; nor will it be so safe and useful in warm as in cold and temperate climates; but to the phlegmatic and sedentary, a cup of coffee, one or two hours after a meal, or, which is still better, one hour before it, may be of service to promote digestion, and prevent or remove a propensity to sleep. In cases of spasmodic asthma, hypochondriasis, scrofula, diarrhœa, agues, and particularly against narcotic poisons, such as opium, hemlock, &c. coffee often produces the best effects: nor is there a domestic remedy better adapted to relieve periodical headachs which proceed from want of tone, or from debility of the stomach.

Count Rumford in the eighteenth of his Essays has entered into a minute, elaborate, and useful analysis of the powers of this valuable berry, and the best means of infusing it for dietetic purposes. He remarks that "among the numerous luxuries of the table, unknown to our forefathers, coffee may be considered as one of the most valuable. Its taste is very agreeable, and its flavour uncommonly so; but its principal excellence depends on its salubrity, and on its exhilirating quality. It excites cheerfulness, without intoxication; and the pleasing flow of spirits which it occasions, lasts many hours, and is never followed by sadness, languor, or debility. It diffuses over the whole frame a glow of health, and a sense of ease and well-being which is extremely delightful: existence is felt to be a positive enjoyment, and the mental powers are awakened, and rendered uncommonly active." After some other judicious observations on the valuable properties of coffee, and the uncertainty of the result in the common methods of preparing it, the Count proceeds with his subject.

"Different methods have been employed in making coffee; but the preparation of the grain is nearly the same in all of them. It is first roasted in an iron pan, or in a hollow cylinder made of sheet-iron, over a brisk fire; and when, from the colour of the grain, and the peculiar fragrance which it acquires in this process, it is judged to be sufficiently roasted, it is taken from the fire, and suffered to cool. When cold it is pounded in a mortar; or ground in a hand-mill to a coarse powder, and preserved for use.

"Great care must be taken in roasting coffee, not to roast it too

much: as soon as it has acquired a deep cinnamon colour, it should be taken from the fire, and cooled; otherwise much of its aromatic flavour will be dissipated, and its taste will become disagreeably bitter.

"In some parts of Italy, coffee is roasted in a thin Florence flask slightly closed by means of a loose cork. This is held over a clear fire of burning coals, and continually agitated. As no visible vapour ever makes its appearance within the flask, the colour of the coffee may be distinctly seen through the glass, and the proper moment seized for removing the coffee from the fire.

"I have endeavoured to improve this Italian method, by using a thin globular glass vessel with a long narrow cylindrical neck. This globular vessel is six inches in diameter, and its cylindrical neck is one inch in diameter, and eighteen inches long. It is laid down horizontally, and supported in such a manner on a wooden stand as to be easily turned round its axis. The globular vessel projects beyond the stand, and is placed, at a proper height, immediately over a chafing dish of live coals. When this globular vessel is blown insufficiently thin: and when care is taken to keep it constantly turning round, when it is over the fire, there is not the smallest danger of its being injured by the heat, however near it may be to the burning coals.

"In order that coffee may be perfectly good, and very high flavoured, not more than half a pound of the grain should be roasted at once; for, when the quantity is greater, it becomes impossible to regulate the heat in such a manner as to be quite certain of a good result.

"The end of the cylindrical neck of the globular vessel should be closed by a fit cork, having a small slit in one side of it to permit the escape of the vapour out of the vessel. This cork should project about an inch beyond the extremity of the neck of the vessel, in order that it may be used as a handle in turning the vessel round its axis, towards the end of the process, when the neck of the vessel becomes very hot. The progress of the operation, and the moment most proper to put an end to it, may be judged and determined with great certainty, not only by the changes which take place in the colour of the grain, but also by the peculiar fragrance which will first begin to be diffused by it when it is nearly roasted enough. This fragrance is certainly owing to the escape of a volatile, aromatic substance, which did not originally exist, *as*

such, in the grain, but which is formed in the process of roasting it. By keeping the neck of the globular vessel cold, by means of wet cloths, I found means to condense this aromatic substance, together with a large portion of aqueous vapour with which it was mixed.

"The liquor which resulted from this condensation, which had an acid taste, was very high flavoured, and as colourless as the purest water; but it stained the skin of a deep yellow colour, which could not be removed by washing with soap and water; and this stain retained a strong smell of coffee several days.

"I have made several unsuccessful attempts to preserve the fragrant aromatic matter which escapes from the coffee when it is roasting, by transferring it to other substances. Perhaps others may be more fortunate. But I must not suffer myself to be enticed away from my subject by these interesting speculations.

"If the coffee in powder is not well defended from the air, it soon loses its flavour, and becomes of little value; and the liquor is never in so high perfection as when the coffee is made immediately after the grain has been roasted.

"This is a fact well known to those who are accustomed to drinking coffee, in countries where the use of it is not controled by the laws; and if a government is seriously disposed to encourage the general use of coffee, individuals must be permitted to roast it in their own houses.

"As the roasting and grinding of coffee take up some considerable time, and cannot always be done without inconvenience at the moment when the coffee is wanted; I contrived a box for keeping the ground coffee, which I have found by several years' experience, to preserve the coffee much better than any of the vessels commonly used for that purpose. It is a cylindrical box made of strong tin, four inches and a quarter in diameter, and five inches in height, formed as accurately as possible within, to which a piston is so adapted as to close it very exactly; and, when pressed down into it, to remain in the place where it is left, without being in danger of being pushed upwards by the elasticity of the ground coffee which it is destined to confine.

"This piston is composed of a circular plate of very stout tin, which is soldered to the lower part of an elastic hoop of tin, about two inches wide, which is made to fit into the cylindrical box as

exactly as possible, and so as not to be moved up and down in it without employing a considerable force. This hoop is rendered elastic, by means of a number of vertical slits made in the sides of it.

On the upper side of the circular plate of tin, which closes this hoop below, and in the centre of it, there is fixed a strong ring, of about one inch in diameter, which serves instead of a piston rod, or a handle for the piston. The cylindrical box is closed above by a cover, which is fitted to it with care, in order that the air which is shut up within the box (between the piston and the cover) might be well confined."

"Boiling-hot water extracts from coffee, which has been properly roasted and ground, an aromatic substance of an exquisite flavour, together with a considerable quantity of astringent matter, of a bitter but very agreeable taste; but this aromatic substance, which is supposed to be an oil, is extremely volatile, and is so feebly united to the water that it escapes from it into the air with great facility. If a cup of the very best coffee, prepared in the highest perfection, and boiling hot, be placed on a table, in the middle of a large room, and suffered to cool, it will in cooling fill the room with its fragrance; but the coffee, after having become cold, will be found to have lost a great deal of its flavour. If it be again heated, its taste and flavour will be still further impaired; and after it has been heated and cooled two or three times, it will be found to be quite vapid and disgusting. The fragrance diffused through the air is a sure indication that the coffee has lost some of its most volatile parts; and as that liquor is found to have lost its peculiar flavour, and also its exhilarating quality, there can be no doubt but that both these depend on the preservation of those volatile particles which escape into the air with such facility."

"In order that coffee may retain all those aromatic particles which give to that beverage its excellent qualities, nothing more is necessary than to prevent all internal motions among the particles of that liquid; by preventing its being exposed to any change of temperature, either during the time employed in preparing it; or afterwards, till it is served up.

"This may be done by pouring boiling water on the coffee in powder; and surrounding the machine in which the coffee is made, by boiling water; or by the steam of boiling water: for the tem-

perature of boiling water is invariable, (while the pressure of the atmosphere remains the same), and the temperature of steam is the same as that of the boiling water from which it escapes.

"But the temperature of boiling water is preferable to all others for making coffee, not only on account of its constancy, but also on account of its being most favourable to the extraction of all that is valuable in the roasted grain. I found that coffee infused with boiling water was always higher flavoured, and better tasted than when the water used in that process was at a lower temperature."

"As all kinds of agitation must be very detrimental to coffee, not only when made, but also while it is making, it is evident that the method formerly practised, that of putting the ground coffee into a coffee-pot with water, and boiling them together, must be very defective, and must occasion a very great loss. But that is not all; for the coffee which is prepared in that manner can never be good, whatever may be the quantity of ground coffee that is employed. The liquor may no doubt be very bitter, and it commonly is so; and it may possibly contain something that may irritate the nerves, —but the exquisite flavour and exhilarating qualities of good coffee will be wanting."——

"Coffee may easily be too bitter, but it is impossible that it should ever be too fragrant. The very smell of it is reviving, and has often been found to be useful to sick persons, and especially to those who are afflicted with violent head-achs. In short, every thing proves that the volatile, aromatic matter, whatever it may be, that gives flavour to coffee, is what is most valuable in it, and should be preserved with the greatest care, and that, in estimating the strength or richness of that beverage, its fragrance should be much more attended to, than either its bitterness or its astringency."

"One pound averdupois, of good Mocha coffee, which, when properly roasted and ground, weighs only fourteen ounces, serves for making fifty-six full cups of the very best coffee, in my opinion, that can be made.

"The quantity of ground coffee which I use for one full cup, is 108 grains troy, which is rather less than a quarter of an ounce. This coffee, when made, would fill a coffee-cup of the common size, quite full; but I use a larger cup, into which the coffee being

poured boiling hot, on a sufficient quantity of sugar (half an ounce), I pour into it about one-third of its volume of good sweet cream, quite cold. On stirring these liquids together, the coffee is suddenly cooled, and in such a manner as not to be exposed to the loss of any considerable portion of its aromatic particles in that process.

"In making coffee, several circumstances must be carefully attended to: in the first place, the coffee must be ground fine, otherwise the hot water will not have time to penetrate to the centres of the particles; it will merely soften them at their surfaces, and, passing rapidly between them, will carry away but a small part of those aromatic and astringent substances on which the goodness of the liquor entirely depends. In this case, the grounds of the coffee are more valuable than the insipid wash which has been hurried through them, and afterwards served up under the name of coffee.

"As a gill is a measure well known in England, I shall adopt it as a standard measure for a cup of coffee; and as it is inconvenient to fill coffee-cups quite full to the brim, I shall propose coffee-cups to be made of the form and dimensions they now commonly have, or of a size proper for containing 8 1-3d cubic inches of liquor, when filled quite full to the brim. I have found by the results of a great number of experiments, that one quarter of an ounce avoirdupois of ground coffee is quite sufficient to make a gill of most excellent coffee, of the highest possible flavour, and quite strong enough to be agreeable.

"Formerly, the ground coffee being put into a coffee-pot, with a sufficient quantity of water, the coffee-pot was put over the fire, and after the water had been made to boil a certain time, the coffee-pot was removed from the fire, and the grounds having had time to settle, or having been fined down with isinglass, the clear liquor was poured off, and immediately served up in cups.

"From the results of several experiments which I made with great care, in order to ascertain what proportion of the aromatic and volatile particles in the coffee escape, and are left in this process, I found reason to conclude, that it amounts to considerably more than half.

"When coffee is made in the most advantageous manner, the ground coffee is pressed down in a cylindrical vessel, which has its

bottom pierced with many small holes, so as to form a strainer; and a proper quantity of boiling hot water being poured cautiously on this layer of coffee in powder, the water penetrates it by degrees, and after a certain time begins to filter through it. This gradual percolation brings continually a succession of fresh particles of pure water into contact with the ground coffee; and when the last portion of the water has passed through it, every thing capable of being dissolved by the water will be found to be so completely washed out of it, that what remains will be of no kind of value.

"It is however necessary to the complete success of this operation, that the coffee should be ground to a powder sufficiently fine.

"In order that the coffee may be perfectly good, the stratum of ground coffee, on which the boiling water is poured, must be of a certain thickness, and it must be pressed together with a certain degree of force. If it be too thin, or not sufficiently pressed together, the water will pass through it too rapidly; and if the layer of ground coffee be too thick, or if it be too much pressed together, the water will be too long in passing through it, and the taste of the coffee will be injured.

The author recommends as of importance that the surface of the coffee be rendered quite level after it is put into the strainer, before any attempt is made to press it together, that the water in percolating may act equally on every part. For this purpose he uses the following contrivance: "The circular plate of tin, with a rod fastened to its centre, which serves as a rammer for pressing down the ground coffee, has four small projecting square bars, of about one-tenth of an inch in width, fastened to the under side of it, and extending from the circumference of the plate to within about one quarter of an inch of its centre. On turning this plate round its axis, by means of the rod which serves as a handle to it, (the rod being made to occupy the axis of the cylindrical vessel,) the projecting bars are made to level the ground coffee; and after this has been done, and not before, the coffee is pressed together.

"This circular plate is pierced by a great number of small holes, which permit the water to pass through it, and it remains in the cylindrical vessel during the whole of the time that the coffee is making. It reposes on the surface of the ground coffee, and prevents its being thrown out of its place by the water which is poured on it. The

rod which serves as a handle to this circular plate is so short, that it does not prevent the cover of the cylindrical vessel from being put down into its place."

Two-thirds of an inch answers best for the coffee in powder before it is pressed together, and the pressure should be such as to reduce the thickness to something less than *half an inch.*

"A Table, showing the diameters and heights of the cylindrical vessels (or strainers) to be used in making the following quantities of coffee :

Quantity of coffee to be made at once.	Diameter of the Strainer.	Height of the Strainer.
1 cup	$1\frac{1}{2}$ inches	$5\frac{1}{4}$ inches
2 cups	$2\frac{1}{8}$	$5\frac{1}{4}$
3 or 4 cups	$2\frac{3}{4}$	5
5 or 6 cups	$3\frac{1}{2}$	$5\frac{1}{8}$
7 or 8 cups	4	$5\frac{1}{4}$
9 or 10 cups	$4\frac{5}{8}$	$5\frac{1}{3}$
11 or 12 cups	5	$5\frac{1}{2}$."

As these heights are nearly equal, the Count recommends that the strainers be all made of the height of $5\frac{1}{2}$ inches, and suspended in their reservoir at such a height that their bottoms be above the percolated fluid when all has passed through.

"The reservoir and its boiler, he then observes, must be soldered together above, at their brims ; and the reservoir must be suspended in its boiler, in such a manner that its bottom may be about a quarter of an inch above the bottom of the boiler.

"The small quantity of water which it will be necessary to put into the boiler, in order that the reservoir for the coffee may be surrounded by steam, may be introduced by means of a small opening on one side of the boiler, situated above, and near the upper part of its handle.

"The spout through which the coffee is poured out passes through the side of the boiler, and is fixed to it by soldering. The cover of the boiler serves at the same time as a cover for the reservoir, and for the cylindrical strainer; and it is made double, in order more effectually to confine the heat.

"The boiler is fixed below to a hoop, made of sheet-brass, which is pierced with many holes. This hoop, which is one inch in width, and which is firmly fixed to the boiler, serves as a foot to it when it

is set down on a table, and it supports it in such a manner that the bottom of the boiler is elevated to the height of half an inch above the table.

"When the boiler is heated over a spirit lamp, or over a small portable furnace in which charcoal is burnt, as the vapour from the fire will pass off through the holes made in the sides of the hoop, the bottom of the hoop will always remain quite clean, and the table-cloth will not be in danger of being soiled when this coffee-pot is set down on the table.

"As the hoop is in contact with the boiler, in which there will always be some water, it will be so cooled by this water as never to become hot enough to burn the table-cloth.

"The bottom of the boiler may be cleaned occasionally, on the underside, with a brush or a towel; but it should not be made bright; for when it is bright it will be more difficult to heat the water in it than when it is tarnished and of a dark-brown colour.

"But the sides of the boiler should be kept as bright as possible; for, when its external surface is kept clean and bright, the boiler will be less cooled by the surrounding cold bodies, than when its metallic splendour is impaired by neglecting to clean it*.

"As the small quantity of water which is put into the boiler serves merely for generating the steam which is necessary in order to keep the reservoir and its contents constantly boiling-hot; if the reservoir be made of silver, or even of common tin, the boiler may, without the smallest danger, be made of copper; or of copper plated with silver, which will give to the boiler an elegant appearance, and at the same time render it easy to keep it clean on the outside.

"The boiler may likewise be made of tin, and neatly japanned on

* "I have in my possession two porcelain tea-pots, of the same form and dimensions, one of which is gilt all over on the outside, and might easily be mistaken for a gold tea-pot; the other is of its natural white colour, both within and without; being neither painted nor gilt. When they are both filled at the same time with boiling water, and exposed to cool in the same room, that which is gilt retains its heat half as long again as that which is not gilt. The times employed in cooling them a given number of degrees, are as three to two.

"The result of this interesting experiment (which I first made about seven years ago) affords a good and substantial reason for the preference which English ladies have always given to silver tea-pots. The details of this experiment may be seen in a paper published in the Memoirs of the French National Institute for the year 1807."

the outside, provided the hoop to which it is fixed below be made of copper; but this hoop must never be japanned nor painted; and it must always be made of sheet-copper or silver; and the boiler must always be heated over a small portable fire-place or lamp, somewhat less in diameter above, than the hoop on which the boiler is placed.

"In order that the flat bottom of the boiler may not smother and put out the fire, the brim of the small furnace or chafing-dish, which is used, must have six projecting knobs at the upper part of it, each about one quarter of an inch in height, on which the bottom of the boiler may rest.

"If these knobs (which may be the large heads of six nails) be placed at equal distances from each other, the boiler will be well supported; and as the hot vapour from the fire will pass off freely between them, the fire will burn well. As a very small fire is all that can be wanted, no inconvenience whatever will arise from the heating of the boiler on the table, in a dining-room or breakfast-room, especially if a spirit lamp be used; and the quantity of heat wanted is so very small, when the water is put boiling hot into the boiler, that the expense for spirits of wine would not, in London, amount to one penny a day, when coffee is made twice a day for four persons.

"It is a curious fact, but it is nevertheless most certain, that *in some cases*, spirits of wine is cheaper, when employed as fuel, even than wood. With a spirit lamp constructed on Argand's principle, but with a chimney made of thin sheet iron, which I caused to be made about seven years ago, (and which has since become very common in Paris*,) I heated a sufficient quantity of cold water, to make coffee for the breakfast of two persons, and kept the coffee boiling hot, one hour after it was made, with as much spirits of wine as cost *two sous*, or one penny English money."

[*Count Rumford.*

SECTION XVI.

Cocoa.

Cocos.—Linn.

The cocoa-tree is a native of very warm climates. The genus includes five species, which are found in the tropics, India, and South America. Of these, two are highly valuable, the cocos nucifera, or cocoa-nut tree; and the cocos butyracea, or palm-oil tree. We shall glance at each of them.

1. *Cocoa-nut Tree.*

Cocos nucifera.—Linn.

This tree rises to the height of sixty feet, and is slenderer in the middle than towards the top or bottom. The leaves or branches are often fourteen or fifteen feet long, and twenty-eight in number, winged, of a yellow colour, straight and tapering. The pinnæ are green, often three feet long next the trunk, but diminishing in length towards the extremity of the branches, which are fastened at top by brown filamentous threads that grow out of them, of the size of ordinary pack-thread, and are interwoven like a web. The nuts hang at the summit of the trunk in clusters of a dozen each. The incrusted white-meat of the nut is formed of the interior fluid, which is continually concreting as it ascends from the root. The interior fluid, or milk, as it is called, is often upwards of a pint. The leaves are wrought into brooms, mats, sacks, hammocks, and other utensils. In its original production this tree was probably an Asiatic plant; but it is now found in almost all the warm parts of America. It may be propagated in our own country from the ripe nut, which should be kept in large pots of sand during the voyage; and if it should shoot in the course of the passage it will be so much time gained. But the nuts brought to England for sale will seldom answer for the purpose of propagation, as they are almost always plucked before they are ripe, that they may the more safely endure the voyage.

The inhabitants also draw from the tree itself a very agreeable liquor, which the Indians call *sura,* and the Europeans style *palm wine;* and indeed it is little inferior to Spanish white wine, except

in keeping. There are three sorts of palm wine; the first of which is drank within a few hours after it is drawn from the tree, and almost in its original state, when it has a moderate sweetness; the second and third sorts are obtained by fermentation, and the addition of various herbs and roots. The first of these liquors will not intoxicate, but the two latter will. Beside all these advantages which are obtained from the cocoa-tree, the filaments which form the outer coat of the nut are worked into threads, of which very good cordage and cables are made.

2. *Palm-oil Tree.*

Cocos butyracea.—Linn.

This is also a native of South America. The oil from which it derives its specific name is produced by bruising and dissolving the kernels of the fruit in water, without the aid of heat, by which the oil is separated, and rises to the surface, and on being washed two or three times, is rendered fit for use. When brought into this country it is of the consistence of an ointment, and of an orange-yellow colour, with little taste, and of a strong, though not disagreeable, smell. Its use is confined to external applications in pains, tumours, and sprains; but it appears to possess very little, if any, advantage over other bland oils.

[*Linn. Turton. Pantologia.*

SECTION XVII.

Cinnamon Tree.

Laurus Cinnamomum.—Linn.

This valuable and useful bay-tree (for the *generic* term shews the reader sufficiently that it belongs to the bay kind), rises above twenty feet in height; the trunk extends about six feet in length, and one foot and a half in diameter; it sends off numerous branches, which are covered with smooth bark, of a brownish ash colour; the leaves stand in opposite pairs upon short footstalks; they are of an ovalish oblong shape, obtusely pointed, entire, firm, from three to five inches long, of a bright green colour, and marked with three whitish longitudinal nerves; the common peduncles grow from the

younger branches, and after dividing, produce the flowers in a kind of paniculated umbel. The petals are six, oval, pointed, concave, spreading, of a greenish white or yellowish colour, and the three outermost are broader than the others, the filaments are nine, shorter than the corolla, flattish, erect, standing in ternaries, and, at the base of the three innermost, two small round glands are placed; the antheræ are double, and unite over the top of the filament; the germen is oblong, the style simple, of the length of the stamina, and the stigma is depressed and triangular: the fruit is a pulpy pericarpium, resembling a small olive, of a deep blue colour inserted in the corolla, and containing an oblong nut.

The true cinnamon-tree is a native of Ceylon, where, according to Ray, it grows as common in the woods and hedges as the hazel with us, and is used by the Ceylonese for fuel and other domestic purposes. Its cultivation was first attempted in this country about the year 1768 by Mr. Philip Miller, who observes, "that the cinnamon and camphire trees are very near akin," and that if the berries of these trees were procured from the places of their growth, and planted in tubs of earth, the plants might be more easily reared than by layers, which require two years or more before they take root. We wish, however, to caution those who make the trial, to plant this fruit immediately upon being obtained from the tree; for Jacquin remarks, "Cæterum ad sationem transportari semina nequeunt, quum paucos intra dies nuclei corrumpantur, atque effœti evadant *. Ray seems to think that the cassia cinnamomea of Herman, the cassia lignea, and the cassia fistula of the ancient Greek writers, were the same, or varieties of the same species of plant †. But an inquiry of more importance is, whether the cinna-

* Jacquin's Americ. At Ceylon "it is particularly owing to a certain kind of wild doves, which, from their feeding on the fruit of the cinnamon-tree, they call *cinnamon-eaters*, that these trees grow so plentifully in this island." A Seba Phil. Trans. vol. xxxvi. p. 105.

† It is necessary to observe, that the ancient signification of these names is very different from the modern. The younger branches of the tree, with their bark covering them, were called by the Greek writers κιννάμωμον, cinnamomum, and sometimes Ξυλοκασία, or cassia lignea; but when they were divested of their bark, which by its being dried became tubular, this bark was denominated κασία σύριγξ, or cassia fistula.—But as in process of time the wood of this tree was found useless, they stripped the bark from it, and brought that only; which custom prevails at this day. See account of the cinnamon-tree by Dr. Watson, Phil Trans. vol. xlvii.

mon of Ceylon is of the same species as that growing in Malabar, Sumatra, &c. differing only through the influence of the soil and climate in which it grows, or from the culture or manner of curing the cinnamon. Mr. White and Mr. Combes, who have investigated this subject with considerable attention, agree with Gracias, and determine this question in the affirmative *.

The use of the cinnamon-tree is not confined to the bark, for it is remarkable that the leaves, the fruit, and the root, all yield oils of very different qualities, and of considerable value: that produced

* According to many botanical writers, the principal marks of distinction of these plants are to be found in the leaf, which in the cinnamon of Ceylon is more oval and less pointed than the others, and the nerves do not reach to the margin; while in the cinnamon of Sumatra they are said to be continued to the extremity of the leaf.—Respecting the bark it is well known to be less warm and grateful to the taste, manifesting that viscosity on being chewed, which is never observable in the Ceylon cinnamon. But Mr. White, with the assistance of Dr. Matty, carefully compared the specimens of the cinnamon-tree, (commonly called cassia) which he had from Sumatra, with those from Ceylon, preserved in the British Museum, which were the collections of Boerhaave, Courteen, Plukenet, and Petiver, and found the difference so inconsiderable, as fully to justify his opinion. In Murray's edition of the Systema Veg. we find superadded to the description of cassia, "Esse modo Varietatem præcedentis, (cinnam.) foliis angustioribus et obtusioribus," Thunberg in Act. Scockh. 1780, p. 56. The difference of the bark itself is thus stated by Ray, "Officinæ nostræ cassiam ligneam a cinnamomo seu canella distinctam faciunt, cassiam cinnamomo crassiorem plerumque esse colore rubicundiorem, substantiâ duriorem, solidiorem et compactiorem, gustu magis glutinoso, odore quidem et sapore cinnamomum aptius referre, tamen cinnamomo imbecilliorem et minus vegetam esse ex accurata observatione Tho. Johnson." But Mr. White says, "From the specimens I shall now produce, it will most plainly appear, that these differences are merely accidents, arising from the age of the canella, the part of the tree from whence it is gathered, and from the manner of cultivating and curing it." And he observes, "If any conjecture can arise from hence, it may be, that the cinnamon of Ceylon was formerly, as well as that of Sumatra and Malabar, called cassia; but that the Dutch writers, being acquainted with the excellent qualities which the ancients ascribed to their cinnamon, chose to add the name cinnamon to that of cassia; and in process of time they have found the name of cinnamon more profitable than that of cassia, by which we choose to call our canella, to our national loss of many thousands a year." (Phil. Trans. vol. l. p. 887.) How far the reasoning of Mr. White is really well founded, we leave to the judgment of others; it may however be remarked, that his opinion is not a little supported, from the consideration that the cinnamon plant varies exceedingly, even in the island of Ceylon, where Burman collected nine different sorts, and Seba actually describes ten.

from the leaves is called oil of cloves, and oleum malabathri: that obtained from the fruit is extremely fragrant, of a thick consistence, and at Ceylon is made into candles, for the sole use of the king; and the bark of the root not only affords an aromatic essential oil, or what has been called oil of camphor, and of great estimation for its medical use, but also a species of cămphor, which is much purer and whiter than that kept in the shops.

The spice, so well known to us by the name of cinnamon, is the inner bark of the tree *; and those plants produce it in the most perfect state, which are about six or seven years old, but this must vary according to circumstances. Seba says, "Those which grow in the vallies, where the ground is a fine whitish sand, (and there are many such vallies in the island of Ceylon,) will in five years time be fit to have the bark taken off. Others, on the contrary, which stand in a wet slimy soil, must have seven or eight years time to grow before they are ripe enough." And the bark of those trees, which stand in a very dry soil, and much exposed to the sun, has often a bitterish taste, which Seba attributes to "the camphor being by the sun's rays rendered so thin and volatile, that it rises up and mixes with the juice of the tree." The bark, while on the trees, is first freed of its external greenish coat; it is then cut longitudinally, stripped from the trees, and dried in sand, till it becomes fit for the market, when it is of a reddish yellow, or pale rusty iron colour, very light, thin, and curling up into quills or canes, which are somewhat tough, and of a fibrous texture. It is frequently mixed with cassia, which is distinguished from the cinnamon by its taste being remarkably slimy. This bark is one of the most grateful of the aromatics; of a very fragrant smell, and a moderately pungent, glowing, but not fiery taste, accompanied with considerable sweetness, and some degree of astringency. Its aromatic qualities are extracted by water in infusion, but more powerfully by it in distillation, and in both ways also by a proof spirit applied. Cinnamon is a very elegant and useful aromatie, more grateful both to the palate and stomach than most other substances of this class: by

* If you taste the inner membrane of the bark when fresh taken off, you will find it of most exquisite sweetness, whereas the outward part of the bark differs but very little in taste from the common trees; but in drying, the oily and agreeable sweetness communicates and diffuses itself throughout the whole outward part." Seba, l. c.

its astringent quality, it likewise corroborates the viscera, and proves of great service in several kinds of alvine fluxes, and immoderate discharges from the uterus. The aromatic principle is an essential oil, which is obtained by distilling at once large quantities of this spice, or rather cassia, which is usually employed in these operations; and the oil thus separated is so extremely pungent, that on being applied to the skin it produces an eschar.

We have already observed that the cinnamon is one species of the laurus or bay-tree: and before we close the article we will remark, that there are few genera of plants that contain so many excellent, useful, and ornamental species. The whole number, indeed, amount to not less than thirty-four, all natives of warm climates; but the following are sufficient to justify our assertion.

1. Sweet bay. L. nobilis. Leaves lanceolate, veined, perennial; flowers four-cleft, diœcous. There are four or five varieties from a difference of the leaf, which is broad, striped, narrow, or wavy.

2. Cinnamon-tree. L. Cinnamomum. Leaves three-nerved, ovate, oblong; the nerves disappearing towards the tip. The tree is covered with a smooth bark; the flowers are panicled. The liber or inner bark of the branches constitutes the cinnamon of the shops. The trunk of the tree grows to the height of twenty or thirty feet. It is a native of Ceylon.

3. Wild cinnamon. Cassia lignea tree. L. Cassia. Leaves triply nerved, lanceolate. Its fruit is the cassia lignea of the dispensatories. It is a native of Malabar.

4. Camphor-tree. L. Camphora. Leaves triply-nerved; lance-ovate, whitish underneath; flowers on long peduncles, white, and consisting of six petals, each producing a shining purple berry of the size of a pear, but top-shaped. It is a native of the woods of Japan, and exudes an inspissated resinous secretion, which is the camphor of the shops.

5. Alligator pear-tree. L. Persea. Leaves ovate, coriaceous, transversely veined, perennial; flower corymbed, of a dirty white or yellow colour, with an agreeable odour, diffusing itself to a considerable distance. The branches of this tree are soft and succulent; its fruit is of the size and shape of a large pear, and has a delicious and grateful flavour. It is a native of the West Indies.

6. Benjamin-tree. L. Benzoin. Leaves nerveless, ovate, acute, at both ends, entire, annual, veined underneath; stamens from six

to nine; flowers yellow, not succeeded by berries in this country. The tree is a native of Virginia, rising from fifteen to twenty feet. It is sometimes confounded with the true *Benzoin-tree*, which is the Styrax Benzoin.

7. Sassafras-tree. L. Sassafras. Leaves entire, three lobed, downy underneath, from three to six inches long with small yellowish flowers succeeded by black berries in its native country, which is Virginia. The wood affords the sassafras of the shops.

8. L. Castica. Leaves oval, wrinkled, perennial, reticulate with veins; flowers yellow and four-cleft. A poisonous tree of Chili.

9. Deciduous Bay. L. Æstivalis. Leaves veined, oblong, pointed, annual, wrinkled underneath; branches superaxillary. A native of Virginia, with small white flowers succeeded by red berries.

10. Indian Bay. L. Indica. Leaves veined, lanceolate, perennial, flat; branchlets tubercled with scars; flowers racemed: trunk upright, from twenty to thirty feet high, branching regularly; flowers whitish-green, succeeded in its native soil by large oval black berries. A native of Madeira.

The leaves and berries of L. nobilis, which is a native of Italy, but cultivated in our own gardens, possess various medicinal qualities, has a sweet fragrant smell, and an aromatic adstringent taste. The laurus of honorary memory, the distinguished favourite of Apollo, may be naturally supposed to have had no inconsiderable fame as a medicine; but its pharmaceutic uses are so limited in the practice of the present day, that this dignified plant is now rarely employed.

[*Watson. Phil. Trans. vol.* xlvii. *Woodville. Pantologia.*

SECTION XVIII.

Ginger.

Amomum Zinziber.—LINN.

THE ginger plant is a native of the East Indies, and is said to grow in the greatest perfection on the coast of Malabar and in Bengal; but it is now plentifully cultivated in the warmer parts of America, and in the West India islands, from whence chiefly it is imported into Europe. In 1731 it was first introduced into this country by Mr. P. Miller, and is still carefully cultivated in the dry stoves of the curious. The flowers have a sweet fragrant smell, and the

leaves and stalks, especially when bruised, also emit a faint spicy odour, but the hot acrid aromatic taste is entirely confined to the root.

"In Jamaica ginger attains its full height, and flowers about August or September, and fades about the close of the year. When the stalks are entirely withered, the roots are in a proper state for digging: this is generally performed in the months of January and February. After being dug, they are picked, cleansed, and gradually seethed, or scalded in boiling water; they are then spread out, and exposed every day to the sun, till sufficiently dried; and after being divided into parcels of about 100 lbs. weight each, they are packed in bags for the market: this is called the Black Ginger." White ginger is the root of the same plant, but instead of the roots being scalded, by which they acquire the dark appearance of the former, each root is picked, scraped, separately washed, and afterwards dried with great care; of course more than a double expense of labour is incurred, and the market price is proportionably greater. Black ginger loses part of its essential oil by being thus immersed in boiling water; on this account it is less useful for medical and other purposes than the white, which is always good when perfectly sound and free from worm-holes: but that imported from the East Indies is stronger than any we have from Jamaica. Ginger gives out its virtues perfectly to rectified spirit, and in a great measure to water. According to Lewis, its active principles are of a remarkably fixed nature; for a watery infusion of this root being boiled down to a thick consistence, dissolved afresh in a large quantity of water, and strongly boiled down again, the heat and pungency of the root still remained, though with little or nothing of its smell. Ginger is generally considered as an aromatic, less pungent and heating to the system than might be expected from its effects upon the organs of taste.

[*Woodville.*

SECTION XIX.

Pimento, All-spice, or Jamaica Pepper-Tree.

Myrtus Pimenta.—Linn.

The tree that bears this aromatic berry is a handsome myrtle that grows above thirty feet in height, and two in circumference; the branches near the top are much divided, and thickly beset with

leaves, which by their continual verdure always give the tree a beautiful appearance; the bark is very smooth externally, and of a grey colour; the leaves vary in shape and in size, but are commonly about four inches long, veined, pointed, elliptical, and of a deep shining green colour; the flowers are produced in bunches, or panicles, and stand upon subdividing or trichotomous stalks, which usually terminate the branches; the calyx is cut into four roundish segments; the petals are also four, white, small, reflex, oval, and placed opposite to each other between the segments of the calyx; the filaments are numerous, longer than the petals, spreading, of a greenish white colour, and rise from the calyx and upper part of the germen; the antheræ are roundish, and of a pale yellow colour; the style is smooth, simple, and erect; the stigma is obtuse; the germen becomes a round succulent berry, containing two kidney-shaped flattish seeds. This tree is a native of New Spain and the West India islands. In Jamaica it grows very plentifully, and in June, July, and August puts forth its flowers, which, with every part of the tree, breathes an aromatic fragrance *.

The pimento-tree was first introduced and cultivated in this country by Mr. Philip Miller in 1739. Pimento, or the berries of this species of myrtle, are chiefly imported into England from Jamaica, and hence the name Jamaica pepper. It is also named all-spice, from its taste being supposed to resemble that of many different species mixed together.—When the berries arrive at their full growth, but before they begin to ripen †, they are picked from the branches, and exposed to the sun for several days, till they are sufficiently dried; this operation is to be conducted with great care,

* "The leaves and bark are full of aromatic particles, which make them (the planters) extremely cautious of fire in all Pimento Walks; where, if it should once catch, it runs with great fury." Browne, l. c.

† "Such of the berries as come to full maturity do, like many other seeds, lose that aromatic warmth for which they are esteemed, and acquire a taste perfectly like that of Juniper berries, which renders them a very agreeable food for the birds, the most industrious planters of these trees." Browne, l. c. "The berries when ripe are of a dark purple colour, and full of a sweet pulp, which the birds devour greedily, and muting the seeds, afterwards propagate these trees in all parts of the woods. It is thought that the seeds passing through them, in this manner, undergo some fermentation, which fits them better for vegetating than those gathered immediately from the tree; and I believe this is the fact." Long's Jamaica, vol. iii. p. 703.

observing that on the first and second day's exposure they require to be turned very often, and always to be preserved from rain and the evening dews. After this process is completed, which is known by the colour and rattling of the seeds in the berries, they are put up in bags or hogsheads for the market. This spice, which was at first brought over for dietetic uses, has been long employed in the shops as a succedaneum to the more costly oriental aromatics; "it is moderately warm, of an agreeable flavour, somewhat resembling that of a mixture of cloves, cinnamon, and nutmegs. Distilled with water it yields an elegant essential oil, so ponderous as to sink in the water, in taste moderately pungent, in smell and flavour approaching to oil of cloves, or rather a mixture of cloves and nutmegs. To rectified spirit it imparts, by maceration or digestion, the whole of its virtue: in distillation it gives over very little to this menstruum, nearly all its active matter remaining concentrated in the inspissated extract.

SECTION XX.

Mace, or Nutmeg-Tree.

Myristica Aromatica.—LINN.

THE nutmeg-tree genus has three species, some of which have varieties that by several writers have been regarded as distinct species, though erroneously. The three we allude to are the following.

1. Myristica fatua, or wild nutmeg; this grows in Tobago, and rises to the height of an apple-tree; has oblong, lanceolated, downy leaves, and hairy fruit; the nutmeg of which is aromatic, but when given inwardly is narcotic, and occasions drunkenness, delirium, and madness for a time.

2. The myristica sebifera, a tree frequent in Guiana, rising to forty, or even to sixty feet high; on wounding the trunk of which, a thick, acrid, red juice runs out. Aublet says nothing of the nutmegs being aromatic; he only observes, that a yellow fat is obtained from them, which serves many economical and medical purposes, and that the natives make candles of it.

3. The myristica aromatica, or nutmeg, attains the height of thirty feet, producing numerous branches, which rise together in stories, and covered with bark, which of the trunk is a reddish brown, but that of the young branches is of a bright green colour; the leaves are nearly elliptical, pointed, undulated, obliquely nerved,

on the upper side of a bright green, on the under whitish, and stand alternately upon footstalks; the flowers are small, and hang upon slender peduncles, proceeding from the axillæ of the leaves; they are both male and female upon separate trees.

The nutmeg has been supposed to be the comacum of Theophrastus, but there seems little foundation for this opinion; nor can it with more probability be thought to be the chrysobalanos of Galen. Our first knowledge of it was evidently derived from the Arabians; by Avicenna it was called jiausiban, or jausiband, which signifies nut of Banda.

There are two kinds of nutmegs, the one male and the other female. The female is that in common use; the male is longer and more cylindric, but it has less of the fine aromatic flavour than the other. This is very subject to be worm-eaten, and by the Dutch it is strictly prohibited from being packed with the others, because it will give occasion to their being worm eaten too, by the insects getting from one species to the other. An almost exclusive and very lucrative trade in nutmegs from the island of Ceylon was carried on by the Dutch, but it is now transferred to the English, who have become masters of the colony *.

The seeds or kernels called nutmegs are well known, as they have been long used both for culinary and medical purposes. Distilled with water, they yield a large quantity of essential oil, resembling in flavour the spice itself; after the distillation, an insipid sebaceous matter is found swimming on the water; the decoction inspissated, gives an extract of an unctuous, very lightly bitterish taste, and with little or no astringency. Rectified spirit extracts the whole virtue of nutmegs by infusion, but elevates very little of it in distillation; hence the spirituous extract possesses the flavour of the spice in an eminent degree.

Nutmegs, when heated, yield to the press a considerable quantity of limpid yellow oil, which on cooling concretes into a sebaceous consistence. In the shops we meet with three sorts of unctuous substances, called oil of mace, though really expressed from the nutmeg. The best is brought from the East Indies in stone jars; this is of a thick consistence, of the colour of mace, and has an agreeable fragrant smell; the second sort, which is paler-coloured,

* We write this in May, 1814. The approaching peace may restore it, but it will most probably remain with the English.—EDITOR.

and much inferior in quality, comes from Holland in solid masses, generally flat, and of a square figure: the third, which is the worst of all, and usually called common oil of mace, is an artificial composition of sevum, palm oil, and the like, flavoured with a little genuine oil of nutmeg.

In the act of gathering and preparing nutmegs, the natives, when the fruit is ripe, ascend the trees, and gather it by pulling the branches to them with long hooks. Some are employed in opening them immediately, and in taking off the green shell or first rind, which is laid together in a heap in the woods, where in time it putrefies. As soon as the putrefaction has taken place, there spring up a kind of mushrooms, called boleti moschatyni, of a blackish colour, and much valued by the natives, who consider them as delicate eating. When the nuts are stripped of their first rind, they are carried home, and the mace is carefully taken off with a small knife. The mace, which is of a beautiful red, but afterwards assumes a darkish red colour, is laid to dry in the sun for the space of a day, and is then removed to a place less exposed to his rays, where it remains for eight days that it may soften a little. They afterwards moisten it with sea water, to prevent it from drying too much, or from losing its oil. They are careful, however, not to employ too much water, lest it should become putrid, and be devoured by the worms. It is last of all put into small bags, and squeezed very close.

The nuts, which are still covered with their ligneous shell, are for three days exposed to the sun, and afterwards dried before a fire, till they emit a sound when they are shaken; they then beat them with small sticks, in order to remove their shell, which flies off in pieces. These nuts are distributed into three parcels; the first of which contains the largest and most beautiful, which are destined to be brought to Europe; the second contains such as are reserved for the use of the inhabitants; and the third contains the smallest, which are irregular or unripe. These are burnt: and part of the rest is employed for procuring oil by pressure. A pound of them commonly gives three ounces of oil, which has the consistence of tallow, and has entirely the taste of nutmeg. Both the nut and mace, when distilled, afford an essential, transparent, and volatile oil, of an excellent flavour.

The nutmegs which have been thus selected, would soon corrupt

if they were not watered, or rather pickled, with lime-water made from calcined shell-fish, which they dilute with salt water till it attains the consistence of fluid pap. Into this mixture they plunge the nutmegs, contained in small baskets, two or three times, till they are completely covered over with the liquor. They are afterwards laid in a heap, where they heat, and lose their superfluous moisture by evaporation. When they have sweated sufficiently, they are then properly prepared, and fit for a sea-voyage.

The medicinal qualities of nutmeg are supposed to be aromatic, anodyne, stomachic, and astringent; and with a view to the last mentioned effects, it has been much used in diarrhœas and dysenteries. To many people the aromatic flavour of nutmeg is very agreeable; they however should be cautious not to use it in large quantities, as it is apt to affect the head, and even to manifest an hypnotic power in such a degree as to prove extremely dangerous. Bontius speaks of this as a frequent occurrence in India; and Dr. Cullen relates a remarkable instance of this soporific effect of the nutmeg, which fell under his own observation, and hence concludes, that in apoplectic and paralytic cases this spice may be very improper. He observes that a person by mistake took two drams or a little more of powdered nutmeg; he felt it warm in his stomach, without any uneasiness; but in about an hour after he had taken it, he was seized with a drowsiness, which gradually increased to a complete stupor and insensibility; and not long after he was found fallen from his chair, lying on the floor of his chamber in the state mentioned. Being laid abed he fell asleep; but waking a little from time to time, he was quite delirious; and he thus continued alternately sleeping and delirious for several hours. By degrees, however, both these symptoms diminished; so that in about six hours from the time of taking the nutmeg, he was pretty well recovered from both. Although he still complained of head-ache, and some drowsiness, he slept naturally and quietly the following night, and next day was quite in his ordinary health.

The officinal preparations of nutmeg are, a spirit and essential oil; and the nutmeg in substance roasted, to render it more astringent. Both the spice itself and its essential oil enter several compositions, as the confectio aromatica, spiritus ammoniæ, com., &c. Mace possesses qualities similar to those of the nutmeg, but is less astringent, and its oil is supposed to be more volatile and acrid.

[*Linn. Percival. Cullen. Woodville.*

SECTION XXI.

Pepper Plant.

Piper.—LINN.

THE pepper plant genus contains upwards of fifty known varieties, most of them natives of America or the West Indies, but a few of the Cape. The chief are, piper nigrum, or black pepper, so denominated from the colour of its berries, but which, when stripped of their skin and steeped in water, become *white*, and then constitutes the *white* pepper of the shops; piper longum, or long pepper; piper betle, or betel; and piper cubeba, or cubebs.

The black or common pepper-plant is chiefly found in Sumatra; usually planted by a thorny tree, round which it creeps and winds like ivy, which it resembles in its leaf, though it is something larger and of a paler green. Having run up a considerable height, the twigs on which the berries hang bend down, and the fruit appears in clusters nearly as large as bunches of grapes, and of much the same figure, but are distinct, like our currants or elder-berries. They produce no fruit till the third or fourth year, after which they bear for the three following years six or seven pound weight of pepper. In the three next years they decrease one third, both in the quantity and size of the pepper, and thus continue decreasing for four or five years longer. When the plant begins to bear, the branches of the tree, through which it creeps, must be lopped off, lest they intercept the rays of the sun, of which this plant stands much in need. When the clusters of the fruit are formed, care must also be taken to support them with poles, lest the branches should be drawn down by their weight.

The pepper-plant has commonly a white flower in April, which knots in June; and the next month the fruit being green and large, the natives make a rich pickle of it, by steeping it in vinegar. In October it is red, in November it begins to grow black, and in December it is all over black, and consequently ripe. This is generally the case, though in some places it is ripe sooner.

The fruit being ripe, they cut off the clusters, and dry them in the sun, till the berries fall off the stalk, which, notwithstanding the excessive heat, it does not do in less than fifteen days, during which the clusters are turned from side to side, and covered up at night.

Some of the berries neither change red nor black, but continue white: these are used in medicine, and sold at double the price of the other. But the inhabitants, finding that foreigners want them for the same use, have discovered a way of whitening the others, by taking them while they are red, and washing off the red skin with water and sand, so that nothing remains but the heart of the pepper, which is white.

Pepper thrives in almost every soil between the two extremes which prevail on this island, the sandy and the yellow clay. In the pepper-gardens the ground is marked out into regular squares of six feet, which is the usual distance allowed to the plants, of which there are usually a thousand in each garden. The English East India Company engross the trade of this article; their servants, and the merchants under their protection, being free to deal in every other commodity the country affords. The price for many years paid for the pepper was ten Spanish dollars, or fifty shillings, per *bakar* of five hundred weight; by a late resolution of the company, it was afterwards increased to fifteen dollars, and the present opening with the continent will perhaps produce another advance.

On the island of Borneo there are three sorts of black pepper; the first, called molucca, or lout-pepper, is the best; the second named caytongee-pepper, is a middling sort; and the third, and worst sort, is negaree-pepper, of which they have the greatest quantity, but it is small, hollow, light, and usually full of dust; it should therefore be bought by weight, and not by measure. Here is also white pepper, which is sold at double the price of the black.

The cultivation of the pepper gardens is chiefly the employment of the Chinese who are settled in the country. They do not let the vine which bears the pepper twist round a chinkareen-tree, as is the custom at Sumatra, but drive a pole, or rather strong post, into the ground, so that the vine is not robbed of its nourishment. Forrest asserts, that he has counted seventy and even seventy-five corns of pepper growing upon one stalk, which is more than is produced at Sumatra.

The island of Java originally produced no spice but pepper, which is now sent thence to Europe in great quantities; but its consumption on the island is very inconsiderable, the inhabitants preferring capsicum, or as it is called in Europe, cayan-pepper.

On the island of Madagascar, pepper grows in small quantities,

but no care is taken to cultivate it. It grows in clusters upon shrubs, which trail upon the ground.

In Africa, what constitutes the principal wealth of the part called the Grain Coast, is the abundance of Guinea pepper produced there, in which they have a great trade, not only with all the neighbouring inland nations, but with Europeans.

The plant on which this production grows, differs in size according to the nature of the soil, and other circumstances. It shoots up like other shrubs, and like ivy runs up some neighbouring tree; what grows upon the plant thus supported has a finer flavour, and a hotter and more pungent taste, than what grows wild in the fields. The leaf, which is soft and pointed, is twice as long as it is broad, and in the rainy season has a delicate smell: soon after which it fades, and at the same time loses both its beauty and flavour; but the leaf and buds when in perfection, on being bruised between the fingers, have an agreeable aromatic smell. Under the leaves, and all along the stalk, are small filaments, by which it fixes itself to the nearest tree. Its flower cannot be described, as it buds in those seasons when no trade is carried on with the coast. It is however certain that it does flower: the fruit succeeds, in long, slender, red shells, or pods, separated into four or five cells, and covered with a rind which the negroes believe to be poisonous, and is only a thin film, that soon dies and crumbles. [*Linnæus. Woodville.*

CHAP. V.

MEDICINAL PLANTS.

SECTION I.

Manna-tree.

Fraxinus Ornus.—LINN.

THE fraxinus ornus, or flowering ash, from which, for the most part, we obtain the manna of the shops, greatly resembles our common ash: it is lofty, much branched, and covered with greyish bark. The young shoots produce the leaves, which are pinnated, opposite, and consist of several pair of pinnæ, or small leaves, terminated by

an odd one, pointed, serrated, veined, standing upon footstalks, of an oval or oblong shape, and bright green colour. The flowers grow in close thick branched spikes, and open in May and June. In the specimens generally figured, the flowers are all hermaphrodite; the corol divided into four narrow whitish segments, somewhat longer than the stamens; the two filaments tapering, and crowned with large furrowed erect anthers; the germen oval, and a little compressed; the style short and cylindrical; the capsule is long, flat, membranous, and contains a single flat pointed seed.

This tree is a native of the southern parts of Europe, particularly of Sicily and Calabria*. It was first introduced into England about seventy years ago, by Dr. Uvedale †; and at present adorns many of the gardens of this country.

The Ornus is not the only species of ash which produces Manna; the *rotundifolia* and *excelsior*, especially in Sicily, also afford this drug, though less abundantly. Many other trees and shrubs have likewise been observed, in certain seasons and situations, to emit a sweet juice, which concretes on exposure to the air, and may be considered of the manna kind ‡. In Sicily the three species of the Fraxi-

* The Ornus is observed by Dr. Cirillo to be very common on the famous mountain Garganus, so that the words of Horace may still apply;

———————aut Aquilonibus
Querceta Gargani laborant,
Et foliis viduantur orni. L. ii. Od. 9.

† Vide Hort Kew.

‡ Dr. Cullen is certainly right in supposing "Manna a part of the sugar so universally present in vegetables, and which exudes on the surface of a great number of them;" the qualities of these exudations he thinks are "very little if at all different." The principal trees known to produce these mannas in different climates and seasons, are the larch, (*vide Murray Ap. Med. i. p.* 17.) the fir, (Iac V. Engerstrom in *Physiogr. Salskapets Handl. Vol. i. P.* 3. *p.* 144,) the orange, (De La Hire *Hist. de l'acad. d. sc. de Paris*, 1708.) the walnut, (*Hal. Stirp. Helv. N.* 1624.) the willow, (Mousset in du Hamel. *Physique des arbres, P. i. p.* 152.) the mulberry, (Micheli in Tragioni Tozzetti *Viaggi, Tom.* 6. *p.* 424.) oaks, situated between Merdin and Diarbekir (Niebuhr *Beschreib. v. Arab. p.* 145. Otter, *Voyage en Turquie et en Perse, Vol.* 2. *p.* 264.) also oaks in Persia near Khounsar (Otter. l. c.) the al hagi Maurorum, or the hedysarum alhagi of Linnæus; of this manna Dr. Fothergill presented a specimen to the Royal Society, which he considered as the Tereniabin of the Arabians, (*Phil. Trans. Vol.* 43. *p.* 87.) the cistus ladaniferus in some parts of Spain produces a manna, which, in its recent state, has no purgative quality, and is eaten by the shepherds: so that some fermentation seems necessary to give it a cathartic power, *Vide Dillon's Travels through Spain, p.* 127.)

nus, mentioned above, are regularly cultivated for the purpose of procuring manna, and with this view are planted on the declivity of a hill, with an eastern aspect. After ten years growth, the trees first begin to yield the manna, but they require to be much older before they afford it in any considerable quantity. Although the manna exudes spontaneously upon the trees, yet in order to obtain it more copiously, incisions are made through the bark, by means of a sharp crooked instrument; and the season thought to be the most favourable for instituting this process, is a little before the dog-days commence, when the weather is dry and serene. The incisions are first made in the lower part of the trunk, and repeated at the distance of an inch from the former wound, still extending the incisions upwards as far as the branches, and confining them to one side of the tree, the other side being reserved till the year following, when it undergoes the same treatment. On making these incisions, which are of a longitudinal direction, about a span in length, and nearly two inches wide, a thick whitish juice immediately begins to flow, which gradually hardens on the bark, and in the course of eight days acquires the consistence and appearance in which the manna is imported into Britain, when it is collected in baskets, and afterwards packed in large chests *. Sometimes the manna flows in such abundance from the incisions, that it runs upon the ground, by which it becomes mixed with various impurities, unless prevented, which is commonly attempted, by interspersing large concave leaves, stones, chips of wood, &c. The business of collecting manna usually terminates at the end of September, when the rainy season sets in †.

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* La manne est le principal revenu de ce pays & de quelques autres qui en sont voisins. Il monte dans une bonne annee a vingt-cinq mille Louis d'or. Houel Voyage Pittoresque, tom. 1. p. 53.

† This account is taken from Houel *Voyage Pittoresque*, and Sestini *Lettre della Sicilia*, and related by Murray; to which we shall subjoin Dr. Cirillo's account, communicated to the Royal Society. Vide Vol. 60. p. 233.

"The manner in which the manna is obtained from the Ornus, though very simple, has been yet very much misunderstood by all those who travelled in the kingdom of Naples; and among other things they seem to agree, that the best and purest manna is obtained from the leaves of the tree; but this, I believe, is an opinion taken from the doctrine of the ancients, and received as an incontestible observation, without consulting nature. I never saw such a kind, and all those who are employed in the gathering of the manna, know of none that comes from the leaves. The manna is generally of two kinds; not on account of the

From this account it is evident, that the manna is the *succus proprius* of the tree; any arguments therefore brought to combat the ancient opinion of its being a *mel aërium*, or honey-dew, are wholly unnecessary: that, with which the Israelites were so peculiarly favoured, could only have been produced through miraculous means, and is consequently out of the province of the *natural* historian.— Manna is generally distinguished into different kinds, viz. the manna in tear, the canulated and flaky manna, and the common brown or fat manna. All these varieties seem rather to depend upon their respective purity, and the circumstances in which they are obtained from the plant, than upon any essential difference of the drug: when the juice transudes from the tree very slowly, the manna is always more dry, transparent, and pure, and consequently of more estimation; but when it flows very copiously it concretes into a coarse brown unctuous mass; hence we have a reason, why, by applying

intrinsic quality of them being different, but only because they are got in a different manner. In order to have the manna, those who have the management of the woods of the Orni in the months of July and August, when the weather is very dry and warm, make an oblong incision, and take off from the bark of the tree about three inches in length, and two in breadth; they leave the wound open, and by degrees the manna runs out, and is almost suddenly thickened to its proper consistence, and is found adhering to the bark of the tree. This manna, which is collected in baskets, and goes under the name of *manna grassa*, is put in a dry place, because moist and wet places will soon dissolve it again. This first kind is often in large irregular pieces of a brownish colour, and frequently is full of dust and other impurities. But when the people want to have a very fine manna, they apply to the incision of the bark, thin straw, or small bits of shrubs, so that the manna, in coming out, runs upon those bodies, and is collected in a sort of regular tubes, which gives it the name of *manna in cannoli*, that is, manna in tubes: this second kind is more esteemed, and always preferred to the other, because it is free and clear. There is indeed a third kind of manna, which is not commonly to be met with, and which I have seen since I left Calabria: it is very white, like sugar; but as it is rather for curiosity than for use, I shall say no more of it. The two sorts of manna already mentioned undergo no kind of preparation whatsoever, before they are exported; sometimes they are finer, particularly the *manna grassa*, and sometimes very dirty and full of impurities; but the Neapolitans have no interest in adulterating the manna, because they always have a great deal more than what they generally export; and if manna is kept in the magazines, it receives often very great hurt by the southern winds, so common in our part of the world. The changes of the weather produce a sudden alteration in the time that the manna is to be gathered; and, for this reason, when the summer is rainy, the manna is always very scarce and very bad."

straws and other substances to receive the flowing juice, the manna becomes much improved: Houel, who tasted the manna when flowing from the tree, found it much bitterer than in its concrete state; this bitterness he attributes to the aqueous part, which is then very abundant, of course the manna is meliorated by all the circumstances which promote evaporation. According to Lewis, "the best manna is in oblong pieces, or flakes, moderately dry, friable, very light, of a whitish or pale yellow colour, and in some degree transparent: the inferior kinds are moist, unctuous, and brown. Manna liquifies in moist air, dissolves readily in water, and, by the assistance of heat, in rectified spirit. On inspissating the watery solution, the manna is recovered of a much darker colour than at first. From the saturated spirituous solution, great part of it separates as the liquor cools, concreting into a flaky mass, of a snowy whiteness, and a very grateful sweetness."

Manna is well known as a gentle purgative, so mild in its operation, that it may be given with safety to children and pregnant women; in some constitutions however it produces troublesome flatulencies, and therefore requires the addition of a suitable aromatic, especially when given to an adult, where a large dose is necessary; it is therefore usually actuated by some other cathartic of a more powerful kind. The efficacy of manna is said, by Vallisnieri, to be much promoted by cassia fistularis, a mixture of the two purging more than both of them separately; it is therefore very properly an ingredient in the electuarium e cassia.

[*Woodville. Cullen. Hort. Kew.*

SECTION. II

Senna-Tree.

Cassia Senna.—Linn.

Cassia in the Linnæan system is a voluminous genus, comprehending not fewer than fifty-four or fifty-six species; of these there are two that furnish useful materials in medicine. C. senna, which belongs to the present section, and C. Fistula, which will be described in the next.

The root of this plant is annual: the stalk is strong, smooth, branched, erect, and rises about two feet in height: the leaves stand in alternate order, and at their base are placed narrow pointed sti-

pulæ: each leaf is composed of several pairs of oval or elliptical pointed nerved sessile pinnæ, of a yellowish green colour: the flowers are yellow, and produced successively in long axillary spikes: the calyx consist of five leafits, which are narrow, obtuse, concave, unequal, and deciduous: the corolla is composed of five petals, which are roundish, concave, entire, and of unequal size: the filaments are ten, of which the three undermost are longer than the others, and furnished with large beaked curved antheræ; the germen stands upon a short pedicle, and is long, compressed, and supplied with a short style, which is turned inwards, and terminated by an obtuse stigma; the seeds are brown, roundish, flat, and produced in a short compressed curved pod, divided by transverse partitions. The flowers appear in July and August.

Senna is a native of Egypt: it also grows in some parts of Arabia, especially about Mocha; but as Alexandria has ever been the great mart from which it has been exported into Europe, it has long been distinguished by the name of Alexandria Senna, or Sena.—Mons. Blondel, who was French Consul at several sea ports of the Levant, informs us, that the true senna grows only in the woods of Ethiopia and in Arabia; for that the senna, which was brought from Saide and Tripoli was carried there by the caravans, and the negative testimony of Alpinus, who in his Lib. de plantis Ægypti does not notice senna, may seem to strengthen this opinion. But as Hasselquist found this plant growing spontaneously in Upper Egypt, the assertion of Mr. Blondel is not to be implicitly received.

The Senna Italica, or blunt-leaved senna, is a variety of the Alexandrian species, which by its cultivation in the south of France, (Provence) has been found to assume this change; it is less purgative than the pointed-leaved senna, and is therefore to be given in larger doses; it was employed as a cathartic by Dr. Wright at Jamaica, where it grows on the sand banks near the sea.

Senna appears to have been cultivated in England in the time of Parkinson (1640); and Miller tells us, that by keeping these plants in a hot-bed all the summer, he frequently had them in flower, but adds, it is very rarely that they perfect their seeds in England. There can be little doubt however but that some of the British possessions may be found well enough adapted to the growth of this vegetable, and that the patriotic views of the Society for encouraging

Arts, &c. which has offered a reward to those who succeed in the attempt, will be ultimately accomplished.

The leaves of senna, which are imported here for medicinal use, have a rather disagreeable smell, and a subacrid bitterish nauseous taste: they give out their virtue both to watery and spirituous menstrua, communicating to water and proof spirit a brownish colour, more or less deep according to the proportions; to rectified spirit a fine green.

Senna, which is in common use as a purgative, was first known to the Arabian physicians, Serapion and Mesue; and the first of the Greeks by whom it is noticed is Actuarius, who does not mention the leaves, but speaks of the fruit. Mesue likewise seems to prefer the pod to the leaves, as being a more efficacious cathartic, but the fact is contrary, for it purges less powerfully than the leaf, though it has the advantage of seldom griping the bowels, and of being without that nauseous bitterness which the leaves are known to possess. How bitterness aids the operation of senna is not easily to be understood; but it is observed by Dr. Cullen, that "when senna was infused in the infusum amarum, a less quantity of the senna was necessary for the dose than the simple infusions of it." The same author has remarked, "that as senna seldom operates without much griping, its frequent use is a proof how much most part of practitioners are guided by imitation and habit." Senna, however, when infused in a large proportion of water, as a dram of the leaves to four ounces of water, rarely occasions much pain of the bowels, and to those who do not object to the bulkiness of the dose, may be found to answer all the purposes of a common cathartic. For covering the taste of senna, Dr. Cullen recommends coriander seeds; but for preventing its griping, he thinks the warmer aromatics, as cardamoms or ginger, would be more effectual. The formulæ given of the senna by the Colleges, are those of an infusion, a powder, a tincture, and an electuary. Its dose in substance is from a scruple to a dram.

[*Lewis. Cullen. Woodville.*

SECTION III.

Purgative Cassia.

Cassia Fistula.—Linn.

We have observed in the preceding section that this is only one of the numerous species belonging to the genus Cassia. This tree frequently rises forty feet in height, producing many spreading branches towards the top, and covered with brownish bark, intersected with many cracks and furrows: the leaves are pinnated, composed of four to six pairs of pinnæ, which are ovate, pointed, undulated, nerved, of a pale green colour, and stand upon shortish footstalks; the flowers are large, yellow, and placed in spikes upon long peduncles: the calyx consists of five oblong blunt greenish crenulated leaves: the corollæ is divided into five petals, which are unequal, spreading, and undulated: the filaments are ten; of these the three undermost are very long and curled inwards; the remaining seven exhibit only the large antheræ, which are all rostrated, or open at the end like a bird's beak: the germen is round, curved inwardly, without any apparent style, and terminated by a simple stigma: the fruit is a cylindrical pendulous pod, from one to two feet in length; at first soft and green, afterwards it becomes brown, and lastly black and shining, divided transversely into numerous cells, in each of which is contained a hard round compressed seed, surrounded with a black pulpy matter. The flowers appear in June and July.

This tree, which is a native of both the Indies, and of Egypt, was first cultivated in England by Mr. Philip Miller in 1731. The pods of the East India Cassia are of less diameter, smoother, and afford a blacker, sweeter, and more grateful pulp than those which are brought from the West Indies, South America, or Egypt, and are universally preferred. In Egypt it is the practice to pluck the Cassia pods before they arrive at a state of maturity, and to place them in a house, from which the external air is excluded as much as possible: the pods are then laid in strata of half a foot in depth, between which palm leaves are interposed; the two following days the whole is sprinkled with water, in order to promote its fermentation: and the fruit is suffered to remain in this situation forty days, when it is sufficiently prepared for keeping.

Those pods, or canes, which are the heaviest, and in which the seeds do not rattle on being shaken, are commonly the best, and contain the most pulp, which is the part medicinally employed, and to be obtained in the manner described in the pharmacopœias.

The best pulp is of a bright shining black colour, and of a sweet taste, with a slight degree of acidity. "It dissolves both in water and in rectified spirit; readily in the former, slowly and difficultly in the latter, and not totally in either: the part which remains undissolved appears to be of little or no activity."

We are told by C. Bauhin, that some have supposed the Siliqua Ægyptiaca of Theophrastus to be our Cassia Fistula; but there seems no evidence of its being known to the ancient Greeks; so that it is with more probability thought that the use of this, as well as of senna, was first discovered by the Arabian physicians.

The pulp of cassia has been long used as a laxative medicine, and being gentle in its operation, and seldom occasioning griping or uneasiness of the bowels, has been thought well adapted to children, and to delicate or pregnant women. Adults, however, find it of little effect, unless taken in a very large dose, as an ounce or more, and therefore to them this pulp is rarely given alone; but usually conjoined with some of the brisker purgatives. It has been observed by Vallisnieri, that its purgative quality is remarkably promoted by manna; but this effect was never discovered in the trials made by Dr. Cullen, in whose opinion the cassia pulp is much of the same nature as the fructus acido dulces; and he says, "that it would certainly be proper for our country apothecaries to know, that the pulp of prunes might be employed in the place of the more expensive and precarious cassia."

By the use of cassia, it has been remarked, that the urine becomes of a green or blackish colour; but Bergius relates, that a young man took an ounce three successive mornings, without producing the least change in the colour of his urine.

The officinal preparation of this drug is the electuarium e cassia: it is also an ingredient in the electuarium e senna, or e. lenitivum.

[*Sennert. Boerhaave. Gmelin. Woodville.*

SECTION IV.

Liquorice Plant.

Glycyrrhiza Glabra.—LINN.

The genus of glycyrrhiza has four species. The glabrous, or that which produces the liquorice of the shops, has a long, thick, creeping root, striking several feet deep into the ground; upright, firm, herbaceous, stalks annual, and three or four feet high, with winged leaves of four or five pairs of oval lobes, terminated by an odd one; and from the axillas erect spikes of pale blue; flowers in July or August, succeeded by short smooth pods.

Liquorice is a native of the South of Europe: it appears to have been cultivated in Britain in the time of Turner *. The chief places at which it has long been propagated for sale, are Pontefract in Yorkshire, Worksop in Nottinghamshire, and Godalming in Surry; but it is now planted by many gardeners in the vicinity of London, by whom the metropolis is supplied with the roots, which, after three years growth, are dug up for use, and are found to be in no respects inferior for medical purposes to those produced in their native climate.

Liquorice root, lightly boiled in a little water, gives out nearly all its sweetness: the decoction, pressed through a strainer, and inspissated with a gentle heat till it will no longer stick to the fingers, affords a better extract than that brought from abroad, and its quantity amounts to near half the weight of the root †. Rectified spirit takes up the sweet matter of the liquorice equally with water; and as it dissolves much less of the insipid mucilaginous substance of the root, the spirituous tinctures and extracts are proportionably sweeter than the watery ‡.

This root contains a great quantity of saccharine matter,§ joined with some proportion of mucilage; and hence has a viscid sweet taste.

* Vide Tourn. Herb. part 2. fol. 12. published in 1562.

† If the liquorice be long boiled, its sweetness is greatly impaired, and the preparation contracts an ungrateful bitterness and black colour.

‡ Lewis, M. M.

§ This matter, according to Lewis, differs from that of other vegetables, "in being far less disposed to run into fermentation." L. c.

From the time of Theophrastus* it has been a received opinion that it very powerfully extinguishes thirst: this, if true, is the more remarkable, as sweet substances in general have a contrary effect †. It is in common use as a pectoral or emollient in catarrhal defluctions on the breast, coughs, hoarsenesses, &c. "Infusions or extracts made from it afford likewise very commodious vehicles or intermedia for the exhibition of other medicines: the liquorice taste concealing that of unpalatable drugs more effectually than syrups or any of the sweets of the saccharine kind ‡."

Theophrast. Plin. Cullen. Woodville.

SECTION V.

Tamarind Tree.

Tamarindus Indica.—LINN.

The Indian tamarind is the only known species of this genus. The tree rises to a great height, sending off numerous large branches, which spread to a considerable extent, and have a beautiful appearance: the trunk is erect, thick, and covered with rough bark of a greyish or ash-colour: the leaves are pinnated, alternate, consisting of several parts (about 14) of small pinnæ, which are opposite, oblong, obtuse, entire, smooth, of a yellowish green colour, and stand upon very short footstalks: the flowers approach to the papilionaceous kind, and are produced in racemi or lateral clusters: the calyx consists of four deciduous leaves, which are patent or reflexed, oblong, or rather ovate, entire, smooth, nearly equal in size, and straw-coloured or yellowish: the petals are three, ovate, concave, acute, indented, and plaited at the edges, about the length of the calyx, and of a yellowish colour, beautifully variegated with red veins: the

* Hence it was named ἄδιψον, and the root directed to be chewed in dropsies and other disorders where great thirst prevailed. Vide Theoph. L. 9. cap. 13. Also noticed by Pliny, Lib. 22. c. 9.

† Dr. Cullen says, "to explain this, I observe that in the sweet of liquorice, separated from the root, I do not find that it quenches thirst more than other sweets; and I take the mistaken notion to have arisen from this, that if a piece of the root is chewed till the whole of the sweetness is extracted, that further chewing brings out the acid and bitterish matter, which stimulates the mouth and fauces, so as to produce an excretion of fluid, and thereby takes off the thirst which the sweetness had produced." *M. M. vol. ii. p.* 407.

‡ Lewis, l. c.

peduncles are about half an inch long, and each furnished with a joint, at which the flower turns inwards: the filaments are commonly three, but in some flowers we have found four, in others only two; they are purple, united at the base, and furnished with incumbent brownish antheræ: the germen is oblong, compressed, incurved, standing upon a short pedicle: the style is tapering, somewhat longer than the filaments, and terminated by an obtuse stigma: the fruit is a pod of roundish compressed form, from three to five inches long, containing two, three, or four flattish angular shining seeds, lodged in a dark pulpy matter, and covered by several rough longitudinal fibres. The flowers, according to Jacquin, appear in October and November.

The generic character of Tamarindus is wholly founded upon this species, as no other of the same family has hitherto been discovered. Though Linnæus in his last edition of the Genera plantarum has followed Jacquin's description of the Tamarindus, in observing that the filaments are united at the base, a circumstance which ought to have placed it in the class Monadelphia, yet notwithstanding this, they neither thought proper to remove it from the class Triandria, where it also has been since retained in Murray's edition of the Systema Vegetabilium; and is consequently thus classed in the systematic arrangement prefixed to the first volume in the first edition of Woodville. Since that time however, we have had an opportunity of examining the recent flower of the Tamarind, from which we have no doubt of its having the true character of the monadelphia class, in which we have now placed it, and for which we have lately had the authority of Schreber, and that of De Loureiro.

This tree, which appears upon various authorities, to be a native of both Indies, America, Egypt, and Arabia, was cultivated in Britain previous to the year 1633; for in Johnson's edition of Gerrard we are told, that in the figure of the Tamarind "*is of a plant some six months old, arisen of a seed: and such by sowing of seeds I have seen growing in the garden of my deceased friend Mr. Tuggy.*" Miller informs us, that Tamarind plants, "if rightly managed, will grow very fast;" adding, "for I have had them upwards of three feet high in one summer, from seed, and have had two plants, which produced flowers the same season they were sown; but this was accidental, for none of the older plants have produced any flowers, although I have several plants of different ages, some of

which are sixteen or eighteen years old, and about twelve feet high, with large spreading tops." To this it may be added, that a healthy tree of this species, now in the Royal Botanic Gardens at Kew, much larger and older than those mentioned by Miller, was not known to flower till a few summers ago; which prevents us from having before a perfect specimen of it.

The pulp of the tamarind, with the seeds, connected together by numerous tough strings or fibres, are brought to us freed from the outer shell, and commonly preserved in syrup. According to Long, tamarinds are prepared for exportation at Jamaica, in the following manner. "The fruit or pods are gathered (in June, July, and August) when full ripe, which is known by their fragility or easy breaking on small pressure between the finger and thumb. The fruit, taken out of the pod, and cleared from the shelly fragments, is placed in layers in a cask; and boiling syrup, just before it begins to granulate, is poured in, till the cask is filled: the syrup pervades every part quite down to the bottom, and when cool the cask is headed for sale." He observes, that the better mode of preserving this fruit is with sugar, well clarafied with eggs, till a transparent syrup is formed, which gives the fruit a much pleasanter flavour: but as a principal medicinal purpose of the pulp depends upon its acidity, which is thus counteracted by the admixture of sugar, it would therefore be of more utility if always imported here in the pods. The fruit produced in the East Indies is more esteemed than that of the West, and easily to be distinguished by the greater length of the pods, and the pulp being dryer, and of a darker colour.

This fruit, the use of which was first learned of the Arabians, contains a larger proportion of acid, with the saccharine matter, than is usually found in the *fructus acido-dulces*, and is therefore not only employed as a laxative, but also for abating thirst and heat in various inflammatory complaints, and for correcting putrid disorders, especially those of a bilious kind; in which the cathartic, antiseptic, and refrigerant qualities of the fruit have been found equally useful. When intended merely as a laxative it may be of advantage to join it with manna, or purgatives of a sweet kind, by which its use is rendered safer and more effectual. Three drams of the pulp are usually sufficient to open the body; but to prove moderately cathartic, one or two ounces are required. It is an ingredient in the well known medicine called lenitive electuary.

"Tournefort relates, that an essential salt may be obtained from tamarinds, by dissolving the pulp in water, and setting the filtered solution, with some oil upon the surface, in a cellar for several months; that the salt is of a sourish taste, and difficultly dissoluble in water; and that a like salt is sometimes found also naturally concreted on the branches of the tree. The salt, Beaumé observes, may be obtained more expeditiously, by clarifying the decoction of the tamarinds with whites of eggs, then filtering it, and evaporating it to a proper consistence, and setting it to cool: the salt shoots into crystals of a brown colour, and very acid taste; but in dissolving and crystallizing them again, or barely washing them with water, they lose almost all their acidity, the acid principle of the tamarinds seeming not to be truly crystallizable."

[*Lewis. Tournefort. Woodville. Cullen.*

SECTION VI.

Jesuits Bark. Peruvian Bark.

Cinchona.—LINN.

SIX species have been discovered as belonging to this genus; all of which are employed for the same medical purpose. We shall enumerate them chiefly from Zea *, since the arrangement of Linnæus, as improved by his learned editors Gmelin and Turton is imperfect, and that of Wildenow less elegant.

1. C. cordifolia. Heart-leaved cinchona on yellow-bark.
2. C. lancifolia. Lance-leaved cinchona, quilled or common bark.
3. C. oblongifolia. Oblong-leaved cinchona, or red bark.
4. C. angustifolia. Narrow-leaved cinchona.
5. C. caribæa. Caribæan cinchona.
6. C. floribunda. St. Lucia cinchona.

The first three species were originally named as we have given them above by Dr. Mutis, 1792, in a publication, entitled, *Papel Periordis de Santa Fe*, who from a residence of more than forty years in South America, had the best opportunities hitherto obtained by any botanist of investigating this important tribe, and whose observations, as we have just glanced at already, are more fully

* Annales de Hist. Nat. vol. ii. 196, Madrid 1800.

detailed in his pupil Zea's communications to the Madrid Annals of Natural History: in consequence of which they have been introduced under the same names into the recent pharmacopœia of the London college. The cinchona officinalis of Linnæus proves to have been termed from specimens of the tree producing the yellow bark, which were sent to him by Mutis, and through mistake confounded with the true Peruvian or quilled bark received by him from Condamine, in compliment to whose earliest and very accurate description, the tree has been named by Humboldt and Bonpland * cinchona Condaminea. From Condamine we shall copy the description of the tree, whose account of it was drawn up from long, careful and accurate observation.

It is a native of Peru, growing most abundantly on a long chain of mountains extending to the north and south of Loxa, where its trunk frequently exceeds in the bulk the body of a man. According to Mr. Arrot, the soil in which these trees thrive best, is generally a red clayey or rocky ground, and especially on the banks of small rivers descending from the high mountains. This author also informs us, that the properest season for cutting off the bark is from September to November, and the manner of conducting this we shall relate below in Mr. Arrot's own words †. On the trees

* Plantes Equinoxiales, tom. i. p. 33.

† "The properest season for cutting the bark is from September to November, the only time in the whole year of some intermission from the rain in the mountains. Having discovered a spot where the trees most abound, they first build huts for the workmen, and then a large hut wherein to put the bark in order to preserve it from the wet; but they let it lie there as short a time as possible, having beforehand cut a road from the place where the trees grow, through the woods, sometimes three or four leagues. to the nearest plantation or farm-house in the low country, whither, if the rain permits them, they carry the bark forthwith to dry. These preparations being made, they provide each Indian (they being the cutters) with a large knife, and a bag that will hold about fifty pounds of green bark: every two Indians take one tree, whence they cut or slice down the bark, as far as they can reach from the ground; they then take sticks about half a yard long each, which they tie to the tree with tough withs at proper distances, like the steps of a ladder, always slicing off the bark as far as they can reach before they fix a new step, and thus mount to the top, the Indian below gathering what the other cuts: this they do by turns, and go from tree to tree until the bag is full, which, when they have plenty of trees, is generally a day's work for one Indian. As much care as possible must be taken that the bark is not cut wet; should it so happen, it is

being entirely stripped of their bark they soon perish; and as the number of these trees to which access could be had, was said to be not very considerable, it has been supposed that a sufficient quantity of bark to supply the demand, could not long be procured. Condamine, however, asserts that the young trees do not die by losing their bark, but send out fresh shoots from the base, and as those which are suffered to become old have time to disseminate and propagate, we trust the fear of exhausting this valuable medicine is wholly groundless.

We seem to have no satisfactory account at what time, or by what means, the medicinal efficacy of the Peruvian bark which is now so well established, was first discovered. Some contend that its use in intermittent fevers was known to the Americans long before the Spaniards possessed Peru, but that they concealed this knowledge from the Europeans; and, on the contrary, it is asserted by others, that the Peruvians never supposed it to be fit for any medicinal use, but thought that the large quantities exported thence was for the purpose of dyeing, and they actually made some trials of its effects in this way. Condamine says, that according to an ancient tradition, the Americans owe the discovery of this remedy to the lions, which some naturalists pretend are subject to a kind of intermitting fever, of which they were observed to be cured by instinctively eating the bark of the cinchona. But Geoffroy states, that the use of the bark was first learned from the following circumstance:—Some cinchona trees being thrown by the winds into a pool of water, lay there till the water became so bitter that every body refused to drink it. However, one of the neighbouring inhabitants being seized with a violent paroxysm of fever, and finding no other water to quench his thirst, was forced to drink this, by which he was perfectly cured. He afterwards related the circumstance to others, and prevailed upon some of his friends who were ill of fevers to make use of the same remedy, with whom it proved

to be carried directly down to the low country to dry; for otherwise it loses its colour, turns black, and rots; and if it lie any time in the hut without being spread, it runs the same risk: so that while the Indians are cutting, the mules if the weather permits ought to be carrying it down to the place appointed for drying it, which is done by spreading it in the open air, and frequently turning it."

equally successful. The use of this excellent medicine, however, was very little known till about the year 1638, when a signal cure having been performed by it on the Spanish viceroy's lady, the Countess del Cinchon, at Lima, it came into general use, and hence was distinguished by the appellation pulvis comitissæ, or the Countess's powder; also called, cortex china china, or chinchina; kina kina, or kinkina; and quina quina, or quinquina. On the recovery of the Countess she distributed a large quantity of the bark to the Jesuits, in whose hands it acquired still greater reputation, and by them it was first introduced into Europe, and thence called cortex, or pulvis jesuiticus, pulvis patrum; and also Cardinal de Lugo's powder, because that charitable prelate bought a large quantity of it at a great expense for the use of the religious poor at Rome.

"This bark is brought to us in pieces of different sizes, some rolled up into short thick quills, and others flat: the outside is brownish, and generally covered in part with a whitish moss: the inside is of a yellowish reddish or rusty iron colour. The best sort breaks close and smooth, and proves friable between the teeth: the inferior kinds appear when broken of a woody texture, and in chewing separate into fibres. The former pulverizes more easily than the latter, and looks, when powdered, of a light brownish colour resembling that of cinnamon, or somewhat paler. It has a slight smell, approaching as it were to mustiness, yet so much of the aromatic kind as not to be disagreeable. Its taste is considerably bitter, astringent, very durable in the mouth, and accompanied with some degree of aromatic warmth, but not sufficient to prevent its being ungrateful."

Besides this bark, that of several other species of cinchona have been recommended for medical use by different authors, especially the cortex peruvianus ruber, or red bark; also that of the cinchona caribæa, or the Jamaica bark; that of cinchona floribunda produced at St. Lucie; and that of two or three other species discovered at Santa Fé. The first of these "is in much larger and thicker pieces than the common, most of the pieces are concave, though not rolled together like the quilled bark. They break short, like the best common bark, and appear evidently composed of three layers. The outer is thin, rugged, frequently covered with a mossy substance, and of a reddish brown colour. The middle is thicker, more com-

pact, and of a darker colour: it is very brittle and resinous. The innermost layer is more woody and fibrous, and of a brighter red. In powdering this bark, the middle layer which seems to contain the greatest proportion of resinous matter, does not break so readily as the rest; a circumstance to be attended to, lest the most active part should be left out of the fine powder. This red bark to the taste discovers all the peculiar flavour of the Peruvian Bark, but much stronger than the common officinal sort. An infusion in cold water is intensely bitter, more so than the strongest decoction of common bark. Its astringency is in an equal degree greater than that of the infusion of common bark, as is shewn by the addition of martial vitriol. The spirituous tincture of the red bark is also proportionally stronger than that of the pale. The quantity of matter extracted by rectified spirit from the powder of the former, was to that from the latter as three to two in one experiment, and as 229 to 130 in another; and yet on infusing the two residuums of the first experiment in boiling water, that of the red bark gave a liquor considerably bitter, and which struck a black with martial vitriol; while that yielded by the other, was nearly tasteless and void of astringency.

Respecting the medicinal properties we have several respectable authorities, shewing, that as the red bark possesses the same virtues with the common, in a much higher degree, so it has been found of more efficacy in the cure of intermittents: and hence it is thought to be that which, according to Arrot, the Spaniards called Cascarilla colorada, and was probably the kind originally brought to Europe, and which proved so successful in the hands of Sydenham, Morton and Lister; for it appears from the testimony of the oldest practitioners, that the bark first employed here was of a much deeper colour than the common bark. The Cinchona caribæa is described and figured by Jacquin and Dr. Wright; it grows in Jamaica, where it is called the Sea Side Beech. According to Dr. Wright, the bark of this tree is not less efficacious than that of the Cinchona of Peru, for which it will prove an useful substitute; but by the experiments of Dr. Skeete it appears to have less astringent power. The Cinchona floribunda, or bark tree of St. Lucie, a figure of which we find in Phil. Trans. also in Rozier's Observations sur la Physique, affords a bark which is likewise said to have been used with advantage; but notwithstanding all that has been written to

establish its medicinal character, it seems to us greatly inferior to that of the other species of this genus. In its recent state it is considerably emetic and cathartic; properties, which in some degree it retains on being dried; so that the stomach does not bear this bark in large doses, and in small ones its effects are not such as to give it any peculiar recommendation. Several plants of Cinchona have lately been discovered at Santa Fé, yielding barks both of the pale and red kind; and which, from their sensible qualities, are likely upon trial to become equally useful with those produced in the kingdom of Peru."

At present, the use of the bark is chiefly confined to the pale and red kind; and the nearer the former resembles the latter, the more it is esteemed.

"The Peruvian Bark yields its virtues both to cold and boiling water; but the decoction is thicker, gives out its taste more readily, and forms an ink with a chalybeate more suddenly than the fresh cold infusion. This infusion, however, contains at least as much extractive matter, but more in a state of solution; and its colour on standing with the chalybeate becomes darker, while that of the decoction becomes more faint. When they are of a certain age, the addition of a chalybeate renders them green; and when this is the case, they are found to be in a state of fermentation, and effete. Milk or caustic alkalies, or lime, precipitate the extractive matter, which in the case of the caustic alkali is re-dissolved by a farther addition of the alkali. Lime-water precipitates less from a fresh infusion than from a fresh decoction; and in the precipitate of this last, some mild earth is perceptible. The infusion is by age reduced to the same state with the fresh decoction, and then they deposit nearly an equal quantity of mild earth and extractive matter; so that lime-water as well as chalybeate, may be used as a test of the relative strength and perishable nature of the different preparations, and of different barks. Accordingly, cold infusions are found by experiments to be less perishable than decoctions; infusions and decoctions of the red bark, than those of the pale: those of the red bark, however, are found by length of time to separate more mild earth with the lime-water, and more extracted matter. Lime-water as precipitating the extracted matter appears an equally improper and disagreeable menstruum. Water has been found to suspend the resin by means of much less gum than has

been supposed. Rectified spirit of wine extracts a bitterness, but no astringency, from a residuum of twenty affusions of cold water; and water extracts astringency, but no bitterness, from the residuum of as many affusions of rectified spirit. The residua of both are insipid.

From many ingenious experiments made on the Peruvian bark by Dr. Irving, published in a Dissertation which gained the prize-medal given by the Harveian Society of Edinburgh in 1783, the power of different menstrua upon Peruvian bark, is ascertained with greater accuracy than had before been done: and it appears, that with respect to comparative power, the following fluids act in the order in which they are placed: Dulcified spirit of vitriol: Caustic ley: French brandy: Rhenish wine: Soft water: Vinegar and water: Dulcified spirit of nitre: Mild volatile alkali: Rectified spirit of wine: Mild vegetable alkali: Lime-water. The antiseptic powers of vinegar and bark united are double their sum taken separately. The astringent power of the bark is increased by acid of vitriol; the bitter taste is destroyed by it.

Though the bark on its first introduction, and even some time afterwards, was reprobated by some eminent physicians as a dangerous remedy; yet these prejudices are entirely done away, and its character is now universally established: so that the disputes which at present subsist are confined to its mode of operation, or the manner in which it is most efficaciously administered. To detail these, however, or even to give a circumstantial relation of the various states of disease in which the bark might be advantageously employed, would far exceed our limits: we are therefore confined to state briefly those diseases to which this medicine is more especially adapted.

The bark first acquired its reputation for the cure of intermittent fevers, and in these, when properly exhibited, it rarely fails of success. For this purpose, some practitioners prefer giving it just before the fit, some during the fit, and others immediately after. Dr. Cullen, who is of the first opinion, says, "I am satisfied that giving a large dose of the bark immediately before the time of accession, is the most proper practice: but as that dose must not be under two drams of pale bark, so there are some stomachs which will not bear even that quantity, or a larger that might be necessary. It is commonly, therefore, convenient to give small doses,

but to give them every hour for some hours near to the times of accession." Some again order it in the quantity of an ounce between the fits; the dose being more frequent and larger according to the frequency of the fits; and this mode of procedure, although it may perhaps lead to the employment of more bark than is necessary, is considered by Dr. Duncan as upon the whole preferable, from being best suited to most stomachs. When the bark pukes, or purges, or oppresses the stomach, it is to be counteracted by remedies particularly appropriated to them. Thus, vomiting is often restrained by exhibiting it in wine; looseness, by combining it with opium; and oppression at the stomach, by the addition of an aromatic. But unless for obviating particular occurrences, it is more successful when exhibited in its simple state than with any addition.

It may be given from the very commencement of the disease without any previous evacuations, though it commonly answers better after emptying the alimentary canal, particularly the stomach; and it is to be continued not only till the paroxysms cease, but till the natural appetite, strength, and complexion return.

In remittent fevers, especially during the times of remission, the bark may also be employed with great success; for as both these and intermittents arise from the same cause, prevail at the same seasons, and assume mutually the form of each other, they show a strict affinity, and found a presumption which is confirmed by experience, that they may be cured by the same remedy. In continued fevers, or typhus of the nervous and putrid kind, the bark is very generally used, as well suited to counteract the debility or putrescency which marks the progress of the disorder. There is, however, one state not unfrequently present in these epidemic fevers, in which the bark is found to be hurtful; i. e. symptoms of congestion, or topical inflammation of the head, manifested by headach, redness of the eyes, and phrenitic delirium. And whenever delirium is accompanied with much subsultus tendinum, or frequent convulsive twitchings of the limbs, Dr. Cullen thinks opium in large doses is the only remedy to which we can trust.

Of late the bark has been much employed in acute rheumatism, particularly after the violence of the disease has been in some measure moderated by the antiphlogistic treatment, or when evident remissions take place. Many, however, have recourse to this medi-

cine in the first stage of the disease, and we have witnessed its success in some of the London Hospitals, even while the inflammatory symptoms prevailed to a very considerable degree. This seems contrary to the experience of Dr. Cullen, who says, "As I consider the disease as especially consisting in a phlogistic diathesis, I hold the bark to be absolutely improper, and have found it manifestly hurtful, especially in its beginning, and in its truly inflammatory state."

In the confluent small-pox the bark has been recommended to promote the rising of the pustules; this opinion our own experience teaches us to reject; but after maturity of the pustules is completed, or where symptoms of putrescency, or a dissolved state of the blood supervenes, the bark cannot be too liberally employed. The other diseases in which the bark is recommended, are gangrenous sore throats, and indeed every species of gangrene; scarletina, disentery, all hemorrhages of the passive kind; likewise other increased discharges; some cases of dropsy, especially when unattended with any particular local affection, scrophula, ill conditioned ulcers, rickets, scurvy, states of convalescence, certain stages of phthisis pulmonalis, &c.

The officinal preparations of the bark are the powder, the extract, the tincture, and the decoction. This last, though frequently employed, is in many respects inferior even to a simple watery infusion; but the best form is that of powder, in which the constituent parts are in the most effectual proportion.

[*Editor. Linnæus. Woodville. Mutis. Zea.*

SECTION VII.

Cascarilla.

Clutia Cascarilla. Croton Cascarilla.—LINN.

THERE is still a difference of opinion concerning the plant which produces the officinal cascarilla. Linnæus observes, Dr. Woodville, whose authority is certainly the best, in his first edition of the Mat. Med. considered the Cascarilla as a species of the Clutia; but in the second edition it is described as a Croton, and in his Amœnitates Academicæ we are again presented with the Clutia Cascarilla. What adds to this uncertainty is, that under both these genera it

is referred to the same synonyma of Sloane and Browne; yet it is remarkable, that neither of these authors notices the medicinal uses of its bark, although so long known as a medicine in great estimation in every part of Europe.

According to Lewis, the Cascarilla bark is imported into Europe "from the Bahama islands, particularly from that which is called Elatheria, in curled pieces, or rolled up into short quills about an inch in width; covered on the outside with a rough whitish matter, and brownish on the inner side, exhibiting, when broken, a smooth close blackish brown surface. This bark, freed from the outer whitish coat, which is insipid and inodorous, has a light agreeable smell, and a moderately bitter taste, accompanied with a considerable aromatic warmth; it is very inflammable, and yields, whilst burning, a remarkably fragrant smell, somewhat resembling that of musk. Its virtues are partially extracted by water, and totally by rectified spirit. Distilled with water it yields a greenish essential oil, of a very pungent taste, and of a fragrant penetrating smell, more grateful than that of the Cascarilla itself, and obtained in the proportion of one dram from sixteen ounces of the bark. The agreeable odour which this bark produces during its burning, induced many to smoke it mixed with tobacco, before it became known as a medicine in Europe, which was not till towards the latter end of the last century: when it was recommended by Professor Stisser, who found it to be a powerful diuretic and carminative, and who used it with success in calculous, asthmatic, phthsical, scorbutic, and arthritic complaints. After this it was sold at Brunswick as a species of the Peruvian bark, and many physicians in Germany experienced its good effects in fevers of the intermittent, remittent, and putrid kind. But while the facts establishing this febrifuge power of the Cascarilla are supported by authors of great respectability, they are yet so little regarded, that this medicine is now very rarely prescribed in fevers, either in this country, or on the neighbouring continent. In intermittents, however, there can be no doubt but this bark, or indeed any other medicine possessing tonic and aromatic qualities, may frequently effect a cure. The German physicians have also given much credit to the Cascarilla as an astringent, and recommended it in hæmorrhages, and various alvine fluxes, in which several instances of its utility are recorded.

Dr. Cullen was in doubt whether to class this drug with the aromatics or with the tonics, but he determined upon the latter as the most proper; besides its being stomachic and corroborant, it is also reported to be diuretic: but proofs of its efficacy in particular diseases have not (as far as we know) been ascertained, nor even attempted by any adequate trials made in this country. We shall not therefore follow a late ingenious author, in depreciating this medicine, from a mere speculation on its sensitive qualities, but rather recommend it to the medical practitioner, as deserving a farther trial. It promises most advantage given in substance, the dose of which is from fifteen grains to a dram.

These are the observations which are given by Dr. Woodville, under the genus Croton, concerning which we shall have to make some further observations in Chapter VII. when treating of another species, Croton sebifera, or tallow-tree; and to which therefore we refer the reader. In describing the genus Clutia, however, which occurs much farther on in his work, Dr. Woodville rejects the croton altogether in favour of this last genus. We have been desirous, says he, of introducing the annexed plate into early notice, in order to determine what was left doubtful in the former part of this work, where the croton cascarilla is figured, on the authority of Linnæus; though at the same time we observed that it did not appear "sufficiently ascertained" whether or no it furnished the officinal cascarilla. This point however we can now confidently decide in the negative.

Among other circumstances, which tended to involve the parental source of cascarilla long in uncertainty, was the assertion of some authors, that it was a native of the Spanish Main, and was thence imported into Europe; thus founding a presumption, that the cascarilla and elatheria barks were different, and that the latter only was the produce of the Bahama Islands. But this assertion we have discovered to be contrary to fact; for, upon inquiry, we do not find that this drug was ever exported from Spanish America, but that the Bahamas have constantly supplied the European markets with cascarilla bark, a parcel of which was sent here from one of those islands, along with specimens of the tree producing it; of which a faithful representation may be seen, as also a specimen of the plant itself, in the herbarium of Sir Joseph Banks.

But it will be necessary to observe here, that Dr. Wright, in his account of the medicinal plants growing in Jamaica, gives the name croton elutheria to a tree, the bark of which he says "is the same as the cascarilla or elutheria of the shops;" it seems therefore probable that different species of clutia may produce bark of the same, or of similar qualities to that of cascarilla, as we find several instances in which the same drug is produced by various species of plants.

That the tree here called by Dr. Wright croton does not belong to this genus, but it is evidently a clutia, appears by the dioicous specimens of it sent by him to the President of the Royal Society; a part of which has the male flowers carefully preserved, so that the Jamaica and Bahama Cascarilla may be compared together.

The Clutia Eluteria seems to have been first introduced into Britain by Mr. P. Miller; but it is not to be found in the King's garden at Kew, nor have we seen it cultivated any where near the metropolis.

This small tree grows several feet in height, and sends of numerous branches, especially towards the top: the bark, which covers the branches is brown and smooth, but that of the trunk is externally more white and rough: the leaves are entire, lanceolate, somewhat cordate, and elongated towards the apex, which is blunt, on the upper side of a bright green, on the under side paler, and placed alternately upon long footstalks. Both the male and female flowers stand in spikes, and are composed of a calyx divided into five ovate leafits, enclosing an equal number of small whitish petals, and within these the nectaria are placed. The female flower produces a roundish germen, supporting three bifid spreading styles, terminated by obtuse stigmata: the capsule is globular, rough, marked with six furrows, and divided into three cells, containing a solitary oval shining seed.

Upon this decision of Woodville, Turton has since introduced the cascarilla as a clutia, or cluytia, as he writes it, into his recent edition of Linnæus, and the same authority has been bowed to by most botanists. Wildenow *, however, has revived the claim of the croton to this species, and the London college, in their late Pharmacopœia, have adopted this last arrangement. The question

* Spec. Plat. iv. 531.

therefore remains unsettled, and the proper place of the plant doubtful *.

[*Editor. Wildenow. Woodville. Wright.*

SECTION VIII.

Angustura.

Casparia Febrifuga.—BONPLAND.

THE bark brought to us from Angustura has at length been discovered by M. M. Humboldt and Bonpland to belong to a tree not before known, and which they promise to describe under the above name in their superb work the *Plantes Equinoxiales*. It is hence given under the above name in the catalogue of the London College, and we have followed the authority. In Woodville's day the characters and properties of the plant were as well known as at present, and he thus describes them, and admits the general inacquaintance of his cotemporaries as to its proper source.

Angustura bark is imported here in thin convex pieces, of about an inch and a half or less in breadth, and about six inches in length. It is not fibrous, but hard, compact, of a yellowish brown colour, and covered with a whitish uneven epidermis. Reduced to powder it has the yellow appearance of rhubarb. To the taste it manifests a bitterish and an aromatic quality, leaving a sensation of heat upon the tongue, which continues for some time. Its odour, when recent, is said to be ungrateful, but in its dried state this is not perceptible. An ounce of this bark affords, by means of alcohol, about two drams of a resinous bitter extract; and nearly three drams and a half of a gummy extract may be obtained from the like quantity, by water.

Some have contended that this drug should be called Augustine, from St. Augustin in East Florida; but it seems more properly named Angustura, which is a place in South America, whence it was brought by the Spaniards to the island of Trinidad.

From what tree it is obtained we find no certain account. It has

* We think it right to inform the reader, that the above description of Woodville is taken from his first edition. We have this moment had an opportunity of turning to his second, and find a correction which coincides with our own observations.—EDITOR.

been supposed to be the bark of the magnolia glauca; but, with more probability, it has been since thought to be that of the brucea antidysenterica *; or brucea ferruginea of L'Heritier and Aiton †: for the description of the bark of this tree, given by Mr. Bruce, agrees very well with the cortex angusturæ; and as far as can be judged by the bark of a living plant of this species, now growing in the Royal Garden at Kew, this opinion is still further confirmed.

During the last twelve years, in which the angustura bark has been known as a medicine in this country, it has been successfully used in the characters of a febrifuge, tonic, and astringent. In intermittents it has been found equally effectual as Peruvian bark, and generally more acceptable to the stomach; and in cases of diarrhæa, dyspepsia, scrophula, and great debility, it has been found to be an useful remedy ‡.

[*Humboldt. Bruce. Miller. Woodville. Powell.*

SECTION IX.

Canella.

Canella alba.—Woodv.

The stem of this tree rises very straight, from ten to fifty feet in height, and branched only at the top; it is covered with a whitish bark, by which it is easily distinguished at a distance from other trees in the woods where it grows: the leaves are placed upon short footstalks, and stand alternately: they are oblong, obtuse, entire, of a dark shining green hue, and thick like those of the laurel: the flowers are small, seldom opening, of a violet colour, and grow in clusters at the tops of the branches upon divided footstalks: the calyx is monophyllus, divided nearly to its base into three lobes, which are roundish, concave, incumbent, green, smooth, membranous, and persistent: the corolla is composed of five petals, which are much longer than the calyx, sessile, oblong, concave, erect, and two of them are somewhat narrower than the other three: the nectary is pitcher-shaped, of the length of the petals, and supports the antheræ instead of filaments, which are wanting: the antheræ

* See Bruce's Travels, &c. vol. v. p. 69, and J. F. Miller, tab. 25.

† Hort. Kew. iii. 397.

‡ See Brande, in London Med. Journal for 1790.

are twenty-one, linear, parallel, distinct, single-valved, and fixed longitudinally to the nectary: the germen is ovate, placed above the insertion of the corolla, and supports a cylindrical style, furnished with two obtuse rough convex stigmata: the fruit is an oblong berry, containing four kidney-shaped seeds of unequal size *.

It appears a little surprising, that the canella, which is a native of the West Indies, and of which figures have been given by Plukenet, Sloane, Catesby, Browne, and others, should have been generally confounded with the tree which produces the cortex winteranus: even the younger Linnæus, who describes this tree under the genus Winterania, from a specimen in the herbarium of Montin, has acknowledged that he could not discover how far it differed from the Drimys or Wintera of Murray.

The well known specimen † which was given by Dr. Swartz, to the Linnæan Society, accompanied with a botanical history of the tree, must, we should think, remove every doubt concerning the true characters of canella alba; and by comparing Woodville's plate with that published of the wintera aromatica, in the fifth volume of Medical Observations and Inquiries by Drs. Fothergill and Solander, it may be observed how far the tree, which produces the cortex winteranus, differs from that of our plant, the bark of which is the officinal canella alba. The latter appears from Clusius to have been first introduced into Britain about the year 1600; the former was known in England twenty years before, and took its name from William Winter, captain of one of the ships which accompanied Sir Francis Drake to the Straits of Magellan, from whence he brought this bark to Europe in 1579. John Bauhin appears to be the first who confounded the names of these barks, by styling the cortex winteranus, Canella alba; and as Sir Hans

* "The whole tree (according to Dr. Swartz) is very aromatic, and when in blossom perfumes the whole neighbourhood. The flowers dried, and softened again in warm water, have a fragrant odour, nearly approaching to that of musk. The leaves have a strong smell of laurel. The berries, after having been some time green, turn blue, and become at last of a black glossy colour, and have a faint aromatic taste and smell. They are, when ripe, as well as the fruit of several kinds of laurel, very agreeable to the white-bellied and baldpate pigeons, (*Columba Jamaicensis* & *leucocephala*), which feeding greedily upon them, acquire that peculiar flavour so much admired in the places where they are found.

† See Woodville, vol. ii. p. 319.

Sloane, who has given a separate description of both trees, and was sensible of a difference in the taste of their barks, seems to insinuate that this might depend upon the place of growth, his remarks did not wholly remove the error.

Professor Murray, in his fourteenth edition of the Systema Vegetabilium, was the first who made a distinct genus of canella, and thus corrected the mistake of Linnæus, who, disregarding the evidence of the old botanists, combined two genera under the name of Laurus winterana; but he afterwards made it a separate genus, and called it Winterania, a name by which it has been long universally, though improperly, distinguished. Mr. Aiton, who has followed Murray in considering the canella, as differing generically from the tree named after Winter, informs us, that it was cultivated by Mr. Philip Miller at Chelsea, in 1739.

The officinal canella alba is the bark of the branches of this tree, freed from its outward covering, and dried in the shade. It is brought to Europe in long quills, which are about three quarters of an inch in diameter, somewhat thicker than cinnamon, and both externally and internally of a whitish or light brown colour, with a yellowish hue, and commonly intermixed with thicker pieces, which are probably obtained from the trunk of the tree. This bark in taste is moderately warm, aromatic, and bitterish; its smell is agreeable, and resembles that of cloves. Its virtues are extracted most perfectly by proof spirit. "In distillation with water it yields an essential oil of a dark yellowish colour, of a thick tenacious consistence, difficultly separable from the aqueous fluid, in smell sufficiently grateful, though rather less so than the bark itself: the remaining decoction, inspissated, leaves an extract of great bitterness, in consistence not uniform, seemingly composed of a resinous and gummy matter, imperfectly mixed. On inspissating the spirituous tincture, the spirit which distils has no great smell or taste of the canella, but is so far impregnated with its more volatile oil, as to turn milky on the admixture of water: the remaining extract retains the bitterness of the bark, but has little more of its warmth or flavour than the extract made with water."

The use of canella alba now supersedes that of the old bark of Winter, on the authority of both the London and Edinburgh pharmacopœias. It has been supposed to possess a considerable share of medicinal power, and is said to be an useful medicine in

the scurvy, and some other complaints; but it is now considered merely in the character of an aromatic, and like many of the spices is chiefly employed for the purpose of correcting and rendering less disagreeable the more powerful and nauseous drugs. It is therefore an ingredient in the aloetic powder of the London college, and in the bitter tincture, bitter wine, &c. of the Edinburgh dispensatory. Swartz tells us, that "this bark, together with the fruit of capsicum, was formerly a common ingredient in the food and drink of the Caribs, the ancient natives of the Antilles; and even at present it makes a necessary addition to the meagre pot of the negroes."

The Wintera aromatica, or Winter's bark, was formerly employed for the medical purposes of the canella of the present day, and was by many botanists, confounded with it.

This last is a very large tree, often rising to the height of fifty feet. It is a native of the Streights of Magellan and Terra del Fuego. Dr. Solander relates that "the tree which produces the Winter's bark was utterly unknown to the Europeans till the return of Captain John Winter, who, in the year 1577, sailed with Sir Francis Drake, as commander of a ship called the Elizabeth, destined for the South Seas; but immediately after they had got through the Streights of Magellan, Captain Winter, on the 8th of October, was obliged, by stress of weather, to part company, and to go back again into the Streights, from whence he returned into England in June 1579, and brought with him several pieces of this aromatic bark, which Clusius called after him Cortex Winteranus. Several authors have mentioned it since in their botanical works; but all they have said has been copied from Clusius. No more was heard of this bark till the Dutch fleet, under Admiral Van Nort, returned from the Streights of Magellan, in the year 1600. Afterwards all the navigators who passed through the Streights of Magellan took notice of the tree, on account of the usefulness of its bark: but none furnished any description that could make it botanically known before Mr. George Handasyd came back from the Streights of Magellan in 1691, and brought with him some dried specimens, which he gave to Sir Hans Sloane, and are now preserved in the British Museum. From these specimens, and the account Mr. Handysyd gave of this tree, Sir Hans Sloane drew up a history, and gave a figure in the Philosophical Transactions. Still the systematical botanists could not give it a place in their catalogues,

being unacquainted with its flowers and fruit." However this loss was supplied by the industry of Mr. Wallis, captain of the Dolphin, who returned from the South Seas in 1768, bringing with him several botanical specimens of the Winter's bark-tree, one of which came into the possession of Dr. John Fothergill, who caused an engraving of it to be made by Ehret, which is published, together with its botanical description written by Dr. Solander, in the fifth volume of the Medical Observations and Inquiries.

[*Murray. Aiton. Miller. Woodville.*

SECTION X.

Myrrh.

Mimosa Troglodyte.—BRUCE.

BOTANY, even medical botany, is still in a very imperfect state, notwithstanding all the pains that have been taken during the last half century, more especially to obtain accuracy. The two or three last sections have offered us proofs of this to a certain extent: and the material before us is still more in point; for at this hour we are totally ignorant of the tree that produces it. This tree we have called, indeed, a Mimosa, upon the authority of Bruce, who regards it as a co-species of the Acacia vera, which is unquestionably a species of mimosa *. His history and description of this ancient and elegant gum-resin is as follows.

"The ancients, and especially Dioscorides, spoke of myrrh in such a manner as to make us suppose, either that they have described a drug which they had never seen; or that the drug seen and described by them is absolutely unknown to modern naturalists and physicians. The Arabs, however, who form the link of the chain between the Greek physicians and ours, in whose country the myrrh was produced, and whose language gave it its name, have left us undeniable evidence, that what we know by the name of myrrh, is in nothing different from the myrrh of the ancients, growing in the same countries from which it was brought formerly to Greece; that is, from the east coast of Arabia Felix, bordering on the Indian Ocean, and that low land in Abyssinia on the south-east of the Red Sea, included nearly between the 12th and 13th degree

* See chapter vii. sect. article Gum Arabic, Mimosa Nilotica.

of north latitude, and limited on the west by a meridian passing through the island Massowa, and on the east by another passing through Cape Guardsoy, without the straits of Babelmandel. This country the Greeks knew by the name of Troglodytia; not to be confounded with another nation of Troglodytes, very different in all respects, living in the forests between Abyssinia and Nubia. The myrrh of the Troglodytes was always, as now, preferred to that of Arabia. That part of Abyssinia being half overrun and settled, half wasted and abandoned, by a barbarous nation from the southward, very little correspondence or commerce has been since carried on between the Arabians and that coast; unless by some desperate adventures of Mahometan merchants, made under accidental circumstances, which have sometimes succeeded, and very often likewise have miscarried.

The most frequent way by which this Troglodyte myrrh is exported, is from Massowa, a small Abyssinian island, on the coast of the Red Sea. Yet the quantity of Abyssinian myrrh is so very small, in comparison of that of Arabia sent to Grand Cairo, that we may safely attribute to this only the reason why our myrrh is not so good in quality as the myrrh of the ancients, which was Abyssinian. Though those barbarians make use of the gum, leaves, and bark of this tree, in diseases to which they are subject, yet as very little is wanted for such purposes, and the tree is the common timber of the country, this does not hinder them from cutting it down every day, to burn for the common uses of life; and as they never plant, or replace the trees destroyed, it is probable that in some years the true Troglodyte myrrh will not exist; and the erroneous descriptions of the Greek physicians will lead posterity, as they have done us now, into various conjectures, all of them false, on the question what that myrrh of the ancients was?

Though the myrrh of the Troglodytes was superior to any Arabian, yet the Greeks perceived that it was not all of equal goodness. Pliny and Theophrastus makes this difference to arise from the trees being partly wild, partly cultivated. But this is an imaginary reason: all the trees were wild. But it was the age of the tree and its health, the manner of making the cut or wound in it, the time of gathering the myrrh, and the circumstances of the climate when it was gathered, that constantly determined, and does yet determine, the quality of the drug. In order to have myrrh of the first, or

most perfect sort, the savages choose a young, vigorous tree, whose bark is without moss, or any parasite plant; and, above the first large branches, give the tree a deep wound with an axe. The myrrh which flows the first year, through this wound, is myrrh of the first growth; and never in very great quantity. This operation is performed some time after the rains have ceased; that is, from April to June, and the myrrh is produced in July and August. The sap once accustomed to issue through this gash, continues to do so spontaneously, at the return of every season: but the tropical rains, which are very violent, and continue six months, wash so much dirt, and lodge so much water in the cut, that in the second year, the tree has begun to rot and turn foul in that part, and the myrrh is of a second quality, and sells in Cairo about a third cheaper than the first. The myrrh also produced from gashes near the roots, and in the trunks of old trees, is of the second growth and quality, and sometimes worse. This however is the good myrrh of the Italian shops every where but in Venice. It is of a blackish red, foul colour, solid and heavy, losing little of its weight by being long kept; and it is not easily distinguished from that of Arabia Felix. The third and worst kind is gathered from old wounds or gashes, formerly made in old trees; or myrrh that, passing unnoticed, has hung upon the tree ungathered a whole year; black and earth-like in colour, and heavy, with little smell and bitterness. This apparently is the caucalis of the ancients.

Pliny speaks of stacte, as if it was fresh or liquid myrrh; and Dioscorides, (cap. 67,) says something like this also. However it is not credible that the ancients, either Greeks or Latins, placed at such a distance, could ever see the myrrh in that state. The natives of its country say, that it hardens on the tree instantly, on being exposed to air; and I, who was several months within 4 days journey of the place where it grew, and had the savages quite at my devotion to go and come from thence, could never see the newest myrrh softer than the state in which I send it; though I think it dissolved more perfectly in water, than when it had been kept. Dioscorides too mentions a kind of myrrh, which he says was green, and of the consistence of paste. But as Serapion and the Arabs say, that stacte was a preparation of myrrh dissolved in water, it is probable, that this unknown green kind of Dioscorides was, like the stacte, a com-

position of myrrh and some other ingredient, not a species of Abyssinian myrrh, which he could never have seen, either soft or green.

It may be remarked, that when we buy fresh or new myrrh, it has always a very strong, rancid, oily smell; and when thrown into water, globules of an oily matter swim upon the surface. This greasiness is not from the myrrh; it is owing to the savages using goat-skins anointed with butter, to make them supple, in which to put their myrrh at gathering; and in these skins it remains, and is brought to market: so that, far from its being a fault, as some ignorant druggists at Rome and Venice believe, it is a mark that the myrrh is fresh gathered, which is the best quality that myrrh of the first sort can have. Besides, far from injuring the myrrh, this oily covering must rather at first have been of service; as it certainly imprisons and confines the volatile parts of new myrrh, which escape in great quantities, to a very considerable diminution in the weight. The piece of myrrh which I send you is what a fine tree, less than fifteen inches diameter in the trunk at the bottom, wounded in two places, produced at one of the wounds in the year 1771. And it may be regarded as the only unexceptionable and authentic evidence in Europe, of what the Troglodyte myrrh was; unless it be those pieces still remaining in my collection, and a piece, somewhat smaller than yours, which I gave to the king of France's cabinet at Paris. This piece which I send you, had lost near six drachms Troy of its weight, between the 27th of August, 1771, and the 29th of June, 1773. It has lost a very few grains since. It was kept, as were all the other pieces, with great care in cotton, separately in a box, to prevent its losing weight by friction.

Opocalpasum.—At the time when I was on the borders of the Tal Tal, or Troglodyte country, I sought to procure myself branches and bark of the myrrh tree, enough preserved to be able to draw it; but the length and ruggedness of the way, the heat of the weather, and the carelessness and want of resources of naked savages, always disappointed me. In those goat-skin bags into which I had often ordered them to put small branches, I always found the leaves mostly in powder; some few that were entire, seemed to resemble much the acacia vera, but were wider towards the extremity, and more pointed immediately at the end. In what order the leaves grew I never could determine. The bark was

absolutely like that of the acacia vera; and among the leaves I often met with a small straight weak thorn, about two inches long. These were all the circumstances I could combine, relative to the myrrh tree, too vague and uncertain to risk a drawing on, when there still remained so many desiderata concerning it; and as the king was obstinate not to let me go thither, after what had happened to the surgeon, mate, and boat's crew of the Elgin Indiaman, I was obliged to abandon the drawing of the myrrh-tree to some more fortunate traveller. At the same time that I was taking these pains about the myrrh, I had desired the savages to bring me all the gums they could find, with the branches and bark of the trees that produced them. They brought me, at different times, some very fine pieces of incense, and at another time, a very small quantity of a bright colourless gum, sweeter on burning than incense; but no branches of either tree, though I found this latter afterwards, in another part of Abyssinia. But at all times they brought me quantities of gum, of an even and close grain, and of a dark brown colour, which was produced by a tree called sassa; and twice I received branches of this tree in tolerable order; and of these I made a drawing. Some weeks after, walking in a Mahometan village, I saw a large tree, with the whole upper part of the trunk and the large branches so covered with great bosses and knobs of gum, as to appear monstrous; and asking further about the tree, I found that it had been brought, many years before, from the myrrh country by merchants, and planted there for the sake of its gum, with which these Mahometans stiffened the blue Surat cloths, which they got damaged from Mocha, to trade in with the Galla and Abyssinians. Neither the tree which they called sassa, nor the name, nor the gum, could allow me to doubt a moment that it was the same as what had been brought to me from the myrrh country; but I had the additional satisfaction to find the tree all covered over with beautiful crimson flowers, of a very extraordinary and strange construction. I began then a drawing anew, with all that satisfaction known only to those who have been conversant in such discoveries. I took pieces of the gum with me. It is very light. Galen complains that, in his time, the myrrh was often mixed with a drug which he calls opocalpasum, by a Greek name; but what this drug was, is totally unknown to us at this day. But as the only view of the savage, in mixing another gum with his myrrh, must

have been to increase the quantity; and as the great plenty in which this gum is produced, and its colour, makes it very proper for this use; and, above all, as there is no reason to think there is another gum-bearing tree, of equal qualities, in the country where the myrrh grows, it seems to me next to a proof that this must have been the opocalpasum.

I must however confess, that Galen says the opocalpasum was so far from an innocent drug, that it was a mortal poison, and had produced very fatal effects. But as those Troglodytes, though now more ignorant than formerly, are still well acquainted with the properties of their herbs and trees, it is not possible that the savage, desiring to increase his sales, would mix them with a poison that must needs diminish them. And we may therefore without scruple suppose, that Galen was mistaken in the quality ascribed to this drug; and that he might have imagined that people died of the opocalpasum, who perhaps really died of the physician. First, because we know of no gum or resin that is a mortal poison: 2dly, because, from the construction of its parts, gum is very ill adapted for having the activity which violent poison has: and considering the small quantities in which myrrh is taken, and the opocalpasum could have been but in an inconsiderable proportion to the myrrh, to have killed, it must have been a very active poison: 3dly, these accidents, from a known cause, must have brought myrrh into disuse, as certainly as the Spaniards mixing arsenic with the bark, would banish that drug when we saw people die of it. Now this never was the case: it maintained its character among the Greeks and the Arabs, and so down to our days; and a modern physician thinks it might make man immortal, if it could be rendered perfectly soluble in the human body.

Galen then was mistaken as to the poisonous quality of the opocalpasum. The Greek physicians knew little of the natural history of Arabia, still less that of Abyssinia; and we who have followed them know nothing of either. This gum, being put into water, swells and turns white, and loses all its glue: it resembles gum adragant much in quality, and may be eaten safely. This specimen came from the Troglodyte country in the year 1771: a piece of myrrh from Arabia Felix, and a piece of gum of the sassa from Abyssinia, were packed up in another separate box, to be sent you for comparison, but forgotten by my servant.

The sassa, the tree which produces the opocalpasum, does not grow in Arabia. Arabian myrrh is easily known from Abyssinian by the following method: take a handful of the smallest pieces, found at the bottom of the basket where the myrrh was packed, and throw them into a plate, and just cover them with water a little warm: the myrrh will remain for some time without visible alteration, for it dissolves slowly; but the gum will swell to five times its original size, and appear so many white spots among the myrrh. The pieces sent are, No. 1, Virgin Troglodyte myrrh. No. 2, the worst sort of Troglodyte myrrh, called cancabs. No. 3, Opocalpasum, from the myrrh country *.

[*Bruce. Phil. Trans.* 1775.

SECTION XI.

Dragon's Blood.

Calamus Rotang.—Woodv.

The calamus is a genus containing nine separate species: three of which supply us with useful and elegant canes; C. sispionum, which affords the common walking-cane; C. verus, which yields the elastic or pliable cane; and C. rotang, which produces the rattan or rotang. This last is also the source of the resin, called dragon's blood. The tree may be considered as a scandent kind of palm: the lower part of the stem, to the extent of two or three fathoms, is strong, erect, hollow, jointed, and beset with numerous spines; afterwards it takes a horizontal direction, and overruns the neighbouring trees to the distance of fifty or even one hundred feet: the leaves are several feet long, and composed of numerons pinnæ, which are nearly a foot long, narrow, sword-shaped, and at the edges serrated with spinous teeth: the flowers are produced in spikes, which separate into long spreading branches: the calyx is divided into six persistent leafits, three exterior and three interior; the former are very short and pointed, the latter are oblong, concave, rigid, and unite closely, so as commonly to conceal the inner parts of the flower: it has no corolla: the filaments are six, capil-

* Some years after this paper was sent to the Royal Society, Mr. Bruce, in his Travels to discover the Source of the Nile, vol. v. gives a few other hints, which render it still more probable that the myrrh tree is a species of mimosa. —Editor.

lary, and furnished with round antheræ: the germen is roundish, placed above the insertion of the calyx, and the style is trifid, filiform, twisted in a spiral manner, and terminated by simple stigmata: the fruit is somewhat larger than that of a filbert, membranous, round, one-celled, covered with regular inverted, obtuse scales, and contains a red resinous pulp, which soon becomes dry: the seed is round and fleshy. It is a native of the East Indies, where it commonly grows in woods near rivers, and has long supplied Europe with walking-canes, which have usually been imported by the Dutch.

According to Linnæus there are several varieties of the calamus rotang, which he has founded upon the different figures of this tree given by Rumphius; but whether these are varieties only, or distinct species, it is not for us to determine. The specimens of the calamus in the herbariums of Sir Joseph Banks and Dr. Smith, differ considerably in their foliage; so that different species of this obscure genus will probably in future be sytematically defined; our business however has only been to select for delineation that which accorded best with the descriptions of it given by Rumphius and Kæmpfer, conformably to the synonyms to which we have referred.

Several trees are known to abound with a red resinous juice, which is obtained by wounding the bark, and called dragon's blood, as the pterocarpus draco or pterocarpus officinalis of Jacquin, the dracaena draco, the dalbergia monetaria, and the pterocarpus sontolinus.—Besides these, many of the Indian red woods, while growing, pour forth through the fissures of the bark a blood-coloured juice, forming a resinous concretion, to which the name dragon's blood has been affixed *. This drug, however, is chiefly obtained from the fruit of the calamus rotang, and is procured at the Molucca Islands, Java, and other parts of the East Indies, according to Kæmpfer, by exposing this fruit to the steam of boiling water,

* As some of the crotons, (vide Linn. Supp. p. 319) and other trees noticed by Cranz, De duabus draconis arboribus, ad, p. 13. An exudation similar to the sanguis draconis produced from a tree at Botany Bay, was discovered by Sir Joseph Banks and Dr. Solander. Vide Hawkesworth's Collection of Voyages, vol. iii p. 498 and 505. But the substance now known at New South Wales by the name of red gum, is perfectly soluble in water; the yellow gum of this place is, however, in its chemical and medicinal qualities, not very different from sanguis draconis, and has been successfully employed as an astringent by Dr. Blane. See Phillips's Voyage to New South Wales, p. 59.

which softens the external shell, and forces out the resinous fluid, which is then inclosed in certain leaves, of the reed kind, and hung in the air to dry. Another way of obtaining the Sanguis Draconis is by simply boiling the fruit in water, inspissating the strained decoction, and drying it in the same manner as the former. In Palimbania the external surface of the ripe fruit is often observed covered with the resin, which is rubbed off by shaking the fruit together in a bag; when this is done, the drug is melted by the sun's heat, and formed into globules, which are folded in leaves: this is deemed the purest kind of dragon's blood; and that which is next in goodness is procured by taking the fruit, which is found to be still distended with resin, out of the bag, and, after bruising it, exposing it to the sun, or boiling it gently in water; the drug then appears floating upon the surface, and is skimmed off and shaped into small cakes. The inferior sort of dragon's blood is that which rises from the crude fruit after being long boiled, and is usually formed into very large cakes or masses, in which the membranous parts of the fruit, and other impurities, are intermixed. It is also brought to us adulterated, or artificially composed, in various ways. Both the small globules and the large masses, which we have noticed, are imported here, and found to vary widely in goodness and purity. The best kind of this gummy resinous substance breaks smooth, is of a dark red colour, and when powdered changes to crimson; it readily melts, and catches flame. It is not acted upon by watery liquors, but it totally dissolves in pure spirit, and soluble likewise in expressed oils. It has no smell, but to the taste discovers some degree of warmth and pungency.

The cinnabris and sanguis draconis appear to have signified the same thing with the ancient Greeks *, who were well acquainted with the astringent power of this medicine; and in this character it has since been much employed in hæmorrhages and alvine fluxes. At present, however, it is rarely used internally, being superseded by more certain and effectual remedies of this numerous class; and it enters no officinal composition but that of emplastrum thuris of the London pharmacopœia. [*Linn. Kæmpfer. Jacquin.*

* Κινναβαρι, αἱμα δρακοντος.

SECTION XII.

Turpentine, Rosin, Pitch, Burgundy-pitch, Frankincense.

Pinus.—Linn.

There are three varieties of pine-tree turpentine commonly known under this name in Europe. 1. The common turpentine, obtained chiefly from the pinus sylvestris (Scotch fir). 2. The Strasburg turpentine, extracted from the pinus picea, (silver fir); and, 3. The Venice turpentine, procured from the pinus laryx (larch). To these may be added two liquid turpentines: as, 4. The Carpathian or Hungary balsam, which exsudes from the pinus lembra (Siberian stone-pine). 5. The Canada balsam, or resinous juice of the pinus balsamea (balm of Gilead fir). The fine fragrant Chio turpentine, is not procured from a pine, but from a low shrub, the pistacea lentiscus.

Of the three first-mentioned turpentines, the Venice is the thinnest and most aromatic; the Strasburgh the next in these qualities; and the common is the firmnest and coarsest. The two former are often adulterated by a mixture of the common turpentine and oil of turpentine; and it is to be observed that the terms Venice and Strasburgh turpentine are not now appropriate, as they are procured from various countries.

Common turpentine is obtained largely in the pine-forests in the south of France, in Switzerland, in the Pyrennees, in Germany, and in many of the southern states of North America; and it has also been occasionally obtained, though in small quantity, in our own country. The greater part of what is consumed in England is, or at least has been till of late, imported from North America. The method of obtaining it is by making a series of incisions through the bark of the tree, from which the turpentine exsudes, and falls into holes or other receptacles at the foot. The age of the fir, when first operated upon, is from thirty to forty years old. The coarse bark is first striped off from the tree, a little above the hole into which the turpentine is designed to run, down to the smooth inner bark: after which a portion of the inner bark, together with a little of the wood, is cut out with a sharp tool, so that there may be a wound in the tree about three inches square and an inch deep.

The working commences about April, and continues through the summer.

"The cutting the trees," says an intelligent writer in the Transactions of the Society of Arts and Manufactures, "for the purpose of collecting is called boxing them, and it is reckoned a good day's work to box sixty in a day; the trees will not run longer than four years, and it is necessary to take off a thin piece of the wood about once a week, and also as often as it rains, as that stops the trees running. While in North Carolina, I was particular in my enquiries respecting the making of tar and pitch, and I saw several tar kilns; they have two sorts of wood that they make it from, both of which are the pitch pine: the sort from which most of it is made are old trees, which have fallen down in the woods, and whose sap is rotted off, and is what they call light wood, not from the weight of it, as it is very heavy, but from its combustible nature, as it will light with a candle, and a piece of it thrown into the fire will give light enough to read and write by. All the pitch-pine will not become light-wood; the people concerned in making tar know it from the appearance of the turpentine in the grain of the wood. The other sort of wood which is used, after the trees which have been boxed for turpentine have done running, they split off the faces over which the turpentine has run; and of this wood is made what is called green tar, being made from green wood instead of dry.

"When a sufficient quantity of wood is got together, the first step is to fix a stake in the ground, to which they fasten a string, and from the stake, as a centre, they describe a circle on the ground according to the size they wish to have the kiln. They consider that one, twenty feet in diameter, and fourteen feet high, should produce them two hundred barrels of tar. They then dig out all the earth a spit deep, shelving inwards within the circle, and sloping to the centre; the earth taken out is thrown up in a bank about one foot and a half high round the edge of the circle; they next get a pine that will split straight, of a sufficient length to reach from the centre of the circle some way beyond the bank; this pine is split through the middle, and both parts are then hollowed out after which they are put together, and sunk in such a way, that one end which comes without the bank, where a hole is dug in the ground for the tar to run into, and whence the tar is taken up and barrelled

as it runs from the kiln. After the kiln is marked out, they bring the wood, ready split up, in small billets, rather smaller than are generally used for the fires in England, and it is then packed as soon as possible, with the end inwards, sloping towards the middle, and the middle is filled up with small wood and the knots of trees, which last have more tar in them than any other part of the wood. The kiln is built in such a way, that at twelve or fourteen feet high it will overhang two or three feet, and it appears quite compact and solid. After the whole of the wood is piled on, they get a parcel of small logs, and then place a line of turf, then another line of logs, and so on alternately all the way up, and the top they cover with two or three thicknesses of turf. After the whole is covered in this way, they take out a turf in ten or a dozen different places round the top, at each of which they light it, and it then burns downwards till the whole of the tar is melted out; and if it burns too fast they stop some of the holes, and if not fast enough they open others, all of which the tar-burner, from practice, is able to judge of. When it begins to run slow, if it is near where charcoal is wanted, they fill up all the holes, and watch it, to prevent the fire breaking out any where till the whole is charred. The charcoal is worth two-pence of three-pence, British sterling, per bushel. It will take six or eight days to burn a tar-kiln; in some places they burn it at such a distance from the shipping, that they have very far to roll it, and even then sell it at from three and sixpence to five shillings, British sterling, per barrel, sometimes taking the whole out in goods, but never less than half the amount in goods; from all which it will be reasonably supposed that tar-burning in that country is but a bad trade, as it must be a good hand to make more than at the rate of a barrel a day; the barrels cost the burner about one shilling and threepence, British sterling, each: the tar-makers are in general very poor, except here and there one, that has an opportunity of making it near the water-side.

"Pitch is made by either boiling the tar till it comes to a proper thickness, or else by burning it; the latter is done by digging a hole in the ground, and lining it with brick, it is then filled with tar, and they set fire to it, and allow it to burn till they judge it has burnt enough, which is known by dipping a stick into it, and letting it cool; when burnt enough they put a cover over it, which stops it

close, and puts out the fire. Five barrels of green tar will make two of pitch: and it will take two barrels of other tar to make one of pitch."

The turpentine thus obtained is loaded with impurities, from which it is freed by two distinct methods. One consists in inclosing it in a cask perforated at bottom, when, by exposure to a hot sun, it becomes so fluid as to filter through, which gives the finest and most valued turpentine. The other method consists in heating it moderately in a large copper, till it is quite liquid, and then filtering it through a strainer made of rows of straws laid close to each other. This gives it a golden colour.

The essential oil of turpentine is prepared largely both in the countries where the turpentine is extracted, and from turpentine imported to our own coasts. The process is as follows: An alembic with a worm and cooler is used, precisely of the same construction as what is employed for the distillation of spirits: this is filled with turpentine and water in due proportions, and the volatile part, after distillation, is found to consist of oil of turpentine swimming on the water. This oil is perfectly limpid and colourless, has a very strong smell, a bitterish taste, is extremely inflammable, and has all the properties of the other essential oils. It is employed in immense quantities in a variety of varnishes and similar preparations; but for the finer purposes, such, for example, as that of dissolving gum copal, it is necessary to rectify it by a second distillation with water in a still, using a very gentle heat, and keeping apart the first product, which is the best. From 250lb. of good turpentine the oil obtained is about 60lb.

Common, or yellow rosin, is the brittle and opaque residue from the distillation of the oil of turpentine. It is called by the French *braisec*; who also obtain it from the hard concrete turpentine that forms about the incisions of the fir-trees, while exsuding. When common rosin is boiled in water for a time, it becomes yellow and transparent; and is then the rosin used by musicians for the bows and strings of violins. When common rosin is kept in fusion for a considerable time it becomes of a browner colour; is still harder and less adhesive to the fingers when cold, and is then called black rosin, or colophony; and this is the ultimate point to which the inspissation of turpentine is carried.

A very fine essential oil is obtained in some parts of Germany by

distillation of the green tops and cones of the stone-pine (pinus-lembra), which is known in medicine by the name of oleum templinum, or popularly, krumholzoel. It is somewhat greenish, or sometimes of a golden yellow, very fragrant and aromatic.

True Burgundy pitch is a kind of rosin prepared in great quantities in the neighbourhood of Neuschatel, from the Norway spruce fir. The turpentine of this fir is peculiarly thick, and hence concretes around the incisions without flowing down. It is in this manner picked off, and when a sufficient quantity is collected, it is put with water into large boilers, melted, and then strained under a press, through close cloths, into barrels, in which it is transported for sale. Burgundy pitch, thus procured, is a brittle, opaque, light-yellow, or sometimes reddish brown rosin, of such consistency that it will barely soften by the heat of the human body; and is hence much used in plaisters. This substance is also sometimes obtained from the larch.

The rosin called frankincense is supposed to exsude spontaneously, and not by incision, from the Norway spruce, and to undergo no preparation. It is brittle, in small roundish masses, of a brownish yellow on the outside, and white internally. It possesses the common properties of the turpentines, and has a very pleasant smell when burnt. Ants, for some unknown purpose, collect this substance, which is found in pieces throughout their nests or hills, and was at one time supposed to be a secretion of their own, and hence distinguished by the name of electrum formicarum, as it was by that of wild frankincense, thus Germanicum, suffimentum silvestre.

All the turpentines in medicine have been considered as hot, stimulating corroborants and detergents; qualities which they possess in in common. They stimulate the stomach, and prove laxative; when carried into the blood-vessels they excite the whole system, and thus render themselves serviceable in chronic rheumatism and paralysis. Turpentine readily passes off by urine, which it imbues with a peculiar odour; also by perspiration and by exhalation from the lungs: and to these respective effects are ascribed the virtues it possesses in gravelly complaints, scurvy and pulmonic disorders. Turpentine is much used in gleets and fluor albus, and in general with much success. The essential oil, in which the virtues of the turpentine reside, is not only preferred for external use as a rubefacient, but also internally as a diuretic and styptic; the latter of which qualifies it pos-

sesses in a very high degree. Formerly turpentine was much used as a digestive application to ulcers, &c. but in the modern practice of surgery it is almost wholly exploded.

[*Pantologia.*

SECTION XIII.

Canadian Balsam Tree.

Pinus balsamea.—LINN.

Carpathian, or Hungarian Balsam.

Pinus lembra.—LINN.

THESE we have already noticed in the preceding section, as the resinous juice, or liquid turpentines of the balm of gilead fir, and the stone pine. The former is mostly in use, and from being less offensive to the stomach, may often with great benefit supersede the use of the balsam of Copaiva. It is transparent, of a light amber colour, and tolerably firm consistence. It is imported into our own country from Canada, whence its name.

[EDITOR.

SECTION XIV.

Balsam of Peru Tree.

Myroxylon Peruiferum.—LINN.

OF this genus there are three species, and all natives of South America. The chief is that before us. It is a native of Peru, Brazil, Mexico, and Terra Firma, with a smooth thick, resinous bark, and leaves abruptly pinnate, in double pairs. This tree was not botanically characterised till the year 1781, when a specimen of it was sent by Mutis, from Terra Firma, to the younger Linnæus, who has described it in the Supplementum Plantarum, under the name of *Myroxylon peruiferum*. Its synonyms are Hoitziloxitl, and Cabureiba *.

Two kinds of this balsam are imported here; the common or black, and the white. The first, which is chiefly used, is about the consistence of a syrup, of a dark opake reddish brown colour, in-

* Hernand. Thes. Rer. Med. Nov. Hisp. Pis. Ind. Hist. Nat. et Mes.

clining to black, and of an agreeable aromatic smell, and a very hot pungent taste.

Balsam of Peru is a very warm aromatic medicine, hotter than any of the other natural balsams; hence, in cold phlegmatic habits, it has been given to warm the constitution, strengthen the nervous system, and attenuate viscid humours.. It has been also used by surgeons in certain wounds and ulcers.

The white balsam of Peru, or white storax, is brought here in gourd shells, and is of a pale yellow colour, thick, and tenacious, becoming by age solid and brittle.

This balsam is less hot than the former, but of a more agreeable fragrant smell, approaching somewhat to that of storax.

[*Mutis. Woodville. Zea.*

SECTION XV.

Balm, or Balsam of Gilead Tree.

Amyris Gileadénsis.—Woodv.

Of this valúable genus nineteen species have been collected in Asia, Africa, and America, almost all of which produce a considerable quantity of terebinthinate rosin or balsam, and several of them of a very grateful taste or flavour. The following are chiefly worthy of notice: 1. a. elemifera, yielding the officinal gum-elemi; 2. a. gileadensis, balsam of Gilead-tree, balsam of Mecca, or Turkey-tree, so called from its yielding this gum; 3. a. toxifera, poison-ash, yielding a liquid gum as black as ink; 4. a. balsamifera. rosewood; an elegant and odoriferous Jamaica tree, of late much and deservedly esteemed by our cabinet-makers. A. toxifera, though poisonous to animals in general, affords a fruit that is nutritive to one or two species of the loxus or grosbeak, which feed on it with great glee.

The vernacular name for the Amyris Gileadensis, or Balm of Gilead Tree, according to Bruce, is Bilessan. It grows to the height of fourteen feet: its branches are numerous, spreading, crooked: the wood is white, soft, and covered with a smooth ash-coloured bark: the leaves are small, few, commonly consisting of one pair of wings, with an odd one at the top: the wings are ses-

sile, inversely ovate, entire, veined, and of a bright green colour: the flowers are scattered upon the branches, and are of a white colour: the calyx is permanent, and divided at the brim into four small pointed teeth: the petals are four, oblong, concave, patent, white: the filaments are eight, tapering, erect, and terminated by oblong antheræ: the germen is egg-shaped, and placed above the insertion of the corolla: the style is thick, of the length of the filaments, and terminated by a quadrangular stigma: the fruit is of the drupaceous kind, roundish, opening by four valves, and containing a smooth nut.

Mr. Bruce informs us, that Balm-tree is a native of Abyssinia, growing among the myrrh-trees behind Azab, all along the coast, to the Straits of Babelmandeb; and that it was early transplanted into the south of Arabia, and into Judea 1000 years before the queen of Saba, who, according to Josephus, gave this tree, among other presents, to king Solomon.

Theophrastus, Dioscorides, Pliny, and even the Arabian physicians, supposed this balsam to be the produce of Judea only; and hence it seems to have received the name of Balsamum Judaicum, or Balm of Gilead. Forskal, who first discovered this tree to belong to the genus Amyris, transmitted a branch of it to Linnæus, which on being broken smelled strongly of the balsam; the leaves were all ternate, a character which corresponds exactly with the specimen in the possession of Sir Joseph Banks.

Besides this tree, which was found at Gidda, another was observed at Yemen, differing only from that found at Gidda, in having pinnated leaves. The former was first described by Linnæus in his Mantissa, under the name of A. Gileadensis, the latter under that of A. Opobalsamum; the name which he has adopted in his Materia Medica.

Whether these two species, the difference of which is supposed to consist merely in the number of their leafits, are really the same or not, we cannot undertake to determine; but judging from analogy we should decide in the affirmative; for even in the figure of this tree, given by Alpinus, to which Linnæus refers the A. Opobalsamum, the number of the leafits varies much, being five, seven, and sometimes three; and in that published by Mr. Bruce, the larger leaves consist of five leafits, but the smaller only of three.

The description of the Balsam of Mecca-tree, lately given by Gleditsch, differs from that of all other writers : he removes it from the genus Amyris, as not having the characters of that family ; we shall therefore leave this author without making any further remark.

This balsam, which has been received in the different pharmacopœias under the names of Balsamum de Mecca, Opobalsamum, Balsamum verum, and Balsamum Gileadense, issues spontaneously from the bark of the tree ; but is more commonly obtained by incisions : the Xylobalsamum, as the name imports, is prepared from the wood, and the Carpobalsamum from the fruit. The balsam now imported into Europe is reported to be principally collected between Mecca and Medina. "The bark," Mr. Bruce says, "is cut by an axe, when the juice is in its strongest circulation in July, August, and the beginning of September. It is then received into a small earthen bottle, and every day's produce gathered and poured into a larger, which is kept closely corked. The Opobalsamum, or juice flowing from the balsam-tree, at first when it is received into the bottle or vase from the wound from whence it issues, is of a light yellow colour, apparently turbid, in which there is a whitish cast, which I apprehend are the globules of air that pervade the whole of it in its first state of fermentation ; it then appears very light upon shaking. As it settles and cools, it turns clear, and loses that milkiness which it first had when flowing from the tree into the bottle. It then has the colour of honey, and appears more fixed and heavy than at first. After being kept for years, it grows of a much deeper yellow, and of the colour of gold. I have some of it which I got from the Cadi of Medina in 1768 ; it is now still deeper in colour, full as much so as the yellowest honey. It is perfectly fluid, and has lost very little either of its taste, smell, or weight. The smell at first is violent, and strongly pungent, giving a sensation to the brain like that of volatile salts when rashly drawn up by an incautious person. This lasts in proportion to its freshness, for, being neglected and the bottle uncorked, it quickly loses this quality, as it probably will at last by age, whatever care is taken of it."

The balsam which one tree yields is very small, and the collecting of it is tedious and troublesome : hence it is so very scarce that

the genuine balsam is rarely if ever exported in a commercial way. The best balsam, according to Alpinus, is at first turbid and white, of a very strong pungent smell, like that of turpentine, but much sweeter and more fragrant, and of a bitter, acrid, astringent taste: on being kept for some time, it becomes thin, limpid, light, of a greenish hue, and then of a gold yellow, after which it grows thick like turpentine, and loses much of its fragrance. Some compare the smell of this balsam to that of citrons; others to that of a mixture of rosemary and sage flowers. The chief mark of its goodness is said to be founded on this, that when dropped on water it spreads itself all over the surface, forming a thin pellicle, tough enough to be taken up upon the point of a pin, and at the same time impregnating the water with its smell and flavour.

It appears on scripture authority, that the great value and use of this drug remounts to very early ages, as it seems coeval with the India trade for pepper. To enumerate all the virtues and medicinal uses still attributed to it by eastern nations, would be outraging the bounds of all rational credibility: but they who are desirous of this information may be gratified by consulting Alpinus. European physicians consider it to be not essentially different from other resinous fluids, or turpentines, especially as we find it imported here: it is therefore generally believed, that the Canada and Copaiva balsams will answer every purpose for which it can be employed. In Turkey it is not only in high esteem as a medicine, but also as an odoriferous unguent and cosmetic: its effects with respect to its last mentioned use seem to depend merely on its stimulating the skin; for it is observed by Lady Mary Wortley Montague, that the day after she had used the balsam, her face became red and swollen; an inconvenience which she suffered for three days.

[*Pantologia. Bruce. Woodville.*

SECTION XVI.

Balsam of Tolu Tree.

Toluifera Balsamum.—Woodv.

This is the only known species of the genus: it is a tree of considerable height, and sends off numerous large branches, and

is covered with rough thick greyish bark; the leaves are elliptical or ovate, entire, pointed, alternate, of a light green colour, and stand upon short strong footstalks; the flowers are numerous, and produced in lateral racemi; the calyx is bell-shaped, divided at the brim into five teeth, which are nearly equal, but one is projected to a greater distance than the others: the petals are inserted into the receptacle, and are five in number, of which four are equal, linear, and a little longer than the calyx: the fifth is much the largest, inversely heart-shaped, and its heel is of the length of the calyx: the ten filaments are very short, and furnished with long antheræ: the germen is oblong: there is no style: the stigma is pointed; the fruit is a round berry.

It grows in Spanish America, in the province of Tolu, behind Carthagena, whence we are supplied with the balsam, which is brought to us in little gourd-shells. This balsam is obtained by making incisions in the bark of the tree, and is collected into spoons, prepared for the occasion, from which it is poured into proper vessels.

This balsam is of a reddish yellow colour, transparent, in consistence thick and tenacious: by age it grows so hard and brittle, that it may be rubbed into a powder between the finger and thumb. Its smell is extremely fragrant, somewhat resembling that of lemons; its taste is warm and sweetish, and on being chewed it adheres to the teeth. Thrown into the fire it immediately liquifies, takes flame, and disperses its agreeable odour. Though it does not dissolve in water, yet if boiled in it for two or three hours, in a covered vessel, the water receives its odoriferous smell: water also suffers a similar impregnation from the balsam by distillation. With the assistance of mucilage it unites with water, so as to form a milky solution. It dissolves entirely in spirit of wine, and easily mixes with distilled oils, but less easily with those of the expressed kind. Distilled without addition, it produces not only an empyreumatic oil, of a pale dark colour, but sometimes a small portion of a saline matter, similar to that of the flowers of benzoine.

This balsam possesses the same general virtues with the former, and that of Peru; it is however less heating and stimulating, and may therefore be employed with more safety. It has been chiefly used as a pectoral, and is said to be an efficacious corroborant in gleets and seminal weaknesses. It is directed by the Pharmaco-

pœias in the syrupus tolutanus, tinctura tolutana, and syrupus balsamicus.

[*J. Banks. Woodville.*

SECTION XVII.

Balsam of Copaiva Tree.

Copaifera Officinalis.—LINN.

THIS is the arbor baccifera Brasiliensis of Ray. The tree grows to a considerable height: it is covered with rough brown bark, and divides into numerous branches: the leaves are pinnated, large, consisting of four pair of pinnæ, which are alternate, except the undermost, which is nearly opposite; they are ovate, pointed, somewhat narrowed on one side, and placed upon short footstalks: the flowers are white, and produced in terminal branched spikes: there is no calyx: the petals are four, oblong, acute, concave, spreading: the filaments are ten, slender, incurved, somewhat longer than the corolla, and crowned with antheræ, which are oblong, and incumbent: the germen is roundish, compressed, and stands upon a short pedicle: the style is filiform, incurved, about the length of the filaments, and furnished with an obtuse stigma: the fruit is an oval pod, of two valves, pointed with part of the remaining style: it contains one egg-shaped seed, involved in a berried tunic.

This tall and elegant tree is a native of South America, particularly Brazil, and some of the neighbouring islands; and it is said to have been discovered growing in the terra firma in large woods with those trees which afford several of our officinal balsams, especially that of Tolu and Peru. The resinous juice, called Balsam of Copaiba, is obtained from this tree by making incisions near the base of its trunk, extending not only through the bark but into the substance of the wood, when the balsam immediately issues, and at the proper season flows in such abundance, that sometimes in three hours twelve pounds have been procured. The older trees afford the best balsam, and yield it two or three times in the same year. The balsam supplied by the young and vigorous trees, which abound with the most juice, is crude and watery, and is therefore accounted less valuable. While flowing from the tree this balsam is a

colourless fluid; in time however it acquires a yellowish tinge, and the consistence of oil; but though by age it has been found thick like honey, yet it never became solid like other resinous fluids.

Genuine * Balsam of Copaiba has a moderately agreeable smell, and a bitterish biting taste, of considerable duration in the mouth: it dissolves entirely in rectified spirit, especially if the menstruum be previously alkalized; when the solution has a very fragrant smell. Distilled with water it yields nearly half its weight of a limpid essential oil; and in a strong heat, without addition, a blue oil.

This, like most other balsams, is nearly allied to the turpentines. It was formerly thought to be an efficacious remedy in various disorders, as pulmonary consumptions, coughs, scorbutic diseases, dropsies, dysenteries, nephritic complaints, internal ulcers, fluor albus, gleets, &c. but though some proofs of its good effects in certain states of many of these diseases may be adduced †, yet as it irritates and heats the system to a considerable degree, few cases occur in which this medicine can safely be given, especially in large doses ‡. It determines powerfully to the kidneys, and impregnates their secretion with its qualities, and has therefore been supposed peculiarly suited to diseases of the urinary passages, but by stimulating these organs it is apt to produce very mischievous consequences, its use is therefore now principally confined to gleets and fluor albus.

If this medicine can be advantageously administered in pulmonary affections, it must be in the absence of fever, and where the excretion from the lungs is unattended with inflammatory congestion §.

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* "We sometimes find in shops, under the name of Copaiba, a thick, whitish, almost opake balsam, with a quantity of turbid watery liquor at the bottom. This sort, probably, is either adulterated by the mixture of other substances, or has been extracted, by boiling in water, from the bark or branches of the tree." Lewis, M. M. p. 132.

† See Fuller, Pharm. extemp. p. 275. F. Hoffman, Obs. Phys. chym. p. 24. Lentin, Beobacht. einig. Krankh. 1774. p. 58. Mutis relates, that a woman in Santa Fé, who had been many years affected with a dropsy, in forty days was cured by taking balsam of copaiba, the dose of which she increased to a spoonful night and morning. Nouvelles de la Republique des lettres et des arts. 1786. n. 33. p. 374.

‡ Hoppe has fully set forth its dangerous effects. See D. Fred. Wilh. Hoppe, apud Valentini Indiam literatam. p. 624.

§ Vide Simmons "On the Treatment of Consumptions," p. 36. sq.—Dr. Cullen says, "Whether a certain effect of balsam of copaiba is to be imputed

it may be most conveniently taken in the form of an emulsion, into which it may be brought by triturating it with almonds, or rather with a thick mucilage of gum-arabic, till they are well incorporated, and then gradually adding a proper quantity of water. The dose of the balsam should rarely exceed twenty or thirty drops.

[*Ray. Woodv. Labat. Cullen.*

SECTION XVIII.

Guaiacum Tree.

Guaiacum Officinale.—LINN.

THIS tree is usually known by the name of *lignum vitæ*. It grows to the height of forty feet, and to the circumference of four or five, sending forth several large dividing and subdividing knotted branches: the bark of the trunk is of a dark grey colour, variegated with greenish or purplish specks, but of the branches it is uniformly ash-coloured, striated, and marked with fissures; "the roots are very thick in proportion to the size of the tree, and run a great way into the ground, in a perpendicular direction:" the leaves are pinnated, consisting of two, three, and sometimes four pair of pinnæ, with very short footstalks, smooth, shining, veined, of an inversely oval shape, and dark green colour: the flowers grow in clusters, or umbels, upon long peduncles, which spring from the divisions of the smaller branches: the calyx is of five leaves; these are concave, oblong, obtuse, patent, unequal, and deciduous; the petals are five, elliptical, concave, spreading, and of a rich blue colour; the stamina are erect, villous, taper from the base, and are crowned with yellowish hooked antheræ; the germen is oval, angular, and in its capsular state assumes the figure we have separately described; the style is short and tapering; the stigma is simple, and pointed; the seeds are solitary, hard, and of an oblong shape.

Linnæus makes three species of the guaiacum, viz. the officinale, sanctum, and afrum; the specific difference between the two former he fixes wholly on the number of the pinnæ of the leaves, defining

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to its laxative quality, I cannot determine, but must observe, that I have learned from an empirical practitioner, that it gives relief in hæmorrhoidal affections; and I have frequently employed it with success, viz. given from twenty to thirty drops twice a day." Mat. Med. vol. ii. p. 190.

the first with *two-paired leaflets*, and the second with *many paired leaflets*; but the leaves, according to the plant we have figured, commonly consist of three, and sometimes four pair of pinnæ, so that this specific description is by no means distinctly characteristic. In a medical sense, the sanctum has been generally considered synonymously with the officinale, and from the investigation we have given this subject, we believe it founded in botanical truth.

This tree is a native of the West India Islands, and the warmer parts of America, and appears from the MS. of Sir Hans Sloane, in the British Museum, to have been first cultivated in this country by the Duchess of Beaufort in 1699. The wood, gum, bark, fruit, and even the flowers of this tree, have been found to possess medicinal qualities. The wood is brought here principally from Jamaica, in large pieces of four or five cwt. each, and, from its hardness and beauty, is in great demand for various articles of turnery ware.—It is extremely compact, and so heavy as to sink in water: the outer part is of a pale yellowish colour, the heart is of a dark blackish brown, with a greater or less admixture of green. It scarcely discovers any smell, unless heated, or while rasping, in which circumstances it yields a light aromatic one; chewed, it impresses a slight acrimony, biting the palate and fauces. Its pungency resides in a resinous matter, which is totally extracted by digestion in rectified spirit, and partially by boiling water. The quantity of solid extract, obtained by rectified spirit, amounts to about one-fourth of the weight of the wood; with water, scarcely one-sixth is obtained. The gum, or rather gummy resin, is obtained by wounding the bark in different parts of the body of the tree, or by what has been called jagging. It exudes copiously from the wounds, though gradually; and when a quantity is found accumulated upon the several wounded trees, hardened by exposure to the sun, it is gathered and packed in small kegs for exportation. This resin is of a friable texture, of a deep greenish colour, and sometimes of a reddish hue; it has a pungent acrid taste, but little or no smell, unless heated. It contains more resin than the watery extract made from the wood; and more gummy matter than the spirituous extract.—The guaiacum tree also yields a spontaneous exudation from the bark, which is called the native gum, and is brought to us in small irregular pieces, of a bright semipellucid appearance, and differs from the former in being much purer. The bark contains less re-

sinous matter than the wood, and is consequently a less powerful medicine, though in a recent state it is strongly cathartic. The fruit, (says a late author) "is purgative; and, for medicinal use, far excels the bark. A decoction of it has been known to cure the venereal disease, and even the yaws in its advanced stage, without the use of mercury." The flowers, or blossoms, are laxative, and in Jamaica are commonly given to children in the form of syrup, which in appearance much resembles that of violets. It is only the wood and resin of Guaiacum which are now in general medical use in Europe; and as the efficacy of the former is supposed to be derived merely from the quantity of resinous matter which it contains, they may be considered indiscriminately as the same medicine. Guaiacum was first introduced in the Materia Medica soon after the discovery of America, and previous to the proper use of mercury in the lues venerea, it was the principal remedy employed for the cure of that disease, and its great success brought it into such repute, that it is said to have been sold for seven gold crowns a pound; but notwithstanding the very numerous testimonies in its favour, it often failed in curing the patient, and was at length entirely superseded by mercury; and though it be still occasionally employed in syphilis, yet it is rather with a view to correct other vitia in the habit, than for its effects as an antivenereal.

The general virtues of guaiacum are stated by Bergius to be detergent, sudorific, diuretic, and stomachic, and its use to be in syphilis, rheumatism, tooth-ach, and cutaneous affections; and to these we may add chronic rheumatism, scrophula, and some scirrhous diseases.—To Dr. Cullen guaiacum seems analogous to the nature of the balsams and turpentines, he therefore supposes it like these to be very diffusible in the system, and thereby to have a considerable power in stimulating the extreme vessels every where; and in this way he accounts for its power in chronic rheumatism, and from its passing off by the pores of the skin, he considers it, like Bergius, a probable remedy in some cutaneous disorders.

In the Philosophical Transactions for 1806, we have a very complete analysis of this substance: by distillation 100 parts yielded

Acidulous water	5.5
Thick brown oil	24.5
Thin empyreumatic oil	29.0
Charcoal	30.5
Gases consisting of carbonic acid and carbureted hydrogen	10.5
	100.0

Hence it is inferred that guaiacum agrees in many respects with the resins, but it differs from them, 1. in the quantity of charcoal it leaves when distilled in close vessels; 2. in the action that nitric acid has upon it; and, 3. in the changes of colour that it undergoes when its solutions are treated with nitric and oxymuriated acids. Its properties may be thus enumerated: it is a solid substance resembling a resin; its colour varies, but is generally greenish; it is readily dissolved in alcohol; alkaline solutions dissolve it with ease; most of the acids act upon it with considerable energy; if digested in water, a portion is dissolved, the water acquiring a greenish-brown colour; the liquid being evaporated, leaves a brown substance which possesses the properties of an extract, being soluble in hot water and alcohol, but scarcely at all in sulphuric ether, and forming precipitates with the muriates of alumina, tin, and silver.

[*Linn. Woodv. Lewis. Pantologia. Phil. Trans.*

SECTION XIX.

Scammony. Jalap.

Convolvulus Scammonia. Convolvulus Jalapa.—WOODV.

THE genus Convolvulus or Bind-wind is very extensive and embraces not less than a hundred and twenty species distributed over the different quarters of the globe. Of these several are medicinal: but the chief are the two enumerated in the title to this section.

1. C. Scammonia. Scammony Bind-weed. This plant grows plentifully about Maraash, Antioch, Edlib, and towards Tripoli in Syria: it was first cultivated in England by Mr. Gerard, in 1597. The root is from three to four feet long, and from nine to twelve inches in circumference, covered with bark of a light grey colour;

it is perennial, tapering, branched towards the bottom, and contains a milky juice; the stalks are numerous, slender, twining, and spread themselves upon the ground, or neighbouring trees, to the extent of fifteen or twenty feet; the leaves are arrow-shaped, smooth, of a bright green colour, and stand upon long footstalks: the flowers are funnel-shaped, yellowish, plicated, and, according to Dr. Russel, placed in pairs upon the pedicles: the calyx is double, consisting of four emarginated leaflets in each row: the capsule is three and sometimes four locular, containing seeds of a pyramidical shape. No part of the dried plant possesses any medicinal quality but the root, which Dr. Russel administered in decoction, and found it to be a pleasant and mild cathartic.

It is from the milky juice of the root that we obtain the officinal Scammony, which is procured in the following manner by the peasants, who collect it in the beginning of June: "Having cleared away the earth from about the root, they cut off the top, in an oblique direction, about two inches below where the stalks spring from it. Under the most depending part of the slope they fix a shell, or some other convenient receptacle, into which the milky juice gradually flows. It is left there about twelve hours, which time is sufficient for draining off the whole juice: this, however, is in small quantity, each root affording but a very few drams. This juice from the several roots is put together, often into the leg of an old boot, for want of some more proper vessel, where in a little time it grows hard, and is the genuine Scammony." This concrete is a gummy-resin, generally of a light, shining, grey colour, and friable texture. It is brought from Aleppo and Smyrna; that which comes from the latter place is less valued than the former, and is supposed to be more ponderous and of a deeper colour; but the colour affords no test of the goodness of this drug, which seems to depend entirely upon the purity of the concrete. The smell of Scammony is rather unpleasant, and the taste bitterish and slightly acrid. The different proportions of gum and resin of which it consists, have been variously stated, but as proof spirit is the best menstruum for it, these substances are supposed to be nearly in equal parts.

Scammony appears to have been well known to the Greek and Arabian physicians, and was not only employed internally as a purgative, but also as an external remedy for tumours, scabies, tinea,

fixed pains, &c. Although this drug was seldom given alone, yet we find it was very generally used, and an ingredient in many compounds which were formerly held in very great repute. Hoffman, however, entertained an opinion, that Scammony was a dangerous medicine; "Ego nunquam in praxi mea in usu habui, nec in posterum habebo; me semper ab istiusmodi venenis colliquativis abstinens." Hoff. in Schrod. p. 543. But since Boerhaave's time it has been considered as a safe though stimulating cathartic, and frequently prescribed uncombined with any other substance, yet neither producing tormina nor hypercatharsis. Like other resinous purgatives it is uncertain in its operation, which may be occasioned by the intestines being more or less defended from the action of these stimulants, by the quantity of natural mucus with which they are covered.

2. C. Jalapa. Jalap Bindweed. The root is perennial, large, ponderous, abounding with a milky juice, of an irregular oval form, and blackish colour; the stalks are numerous, shrubby, slender, twisted, striated, rising above ten feet high, and twining for support round the neighbouring plants; the leaves are various, generally more or less heart-shaped, but often angular, or oblong and pointed; they are smooth, of a bright green colour, and stand alternately upon long footstalks; the flowers are produced from short branches, sending off two peduncles, each of which supports a single flower: this is large, bell-shaped, entire, plicated, externally of a reddish colour, but of a dark purple within; the calyx consists of five oval leaves, these are concave, somewhat indented at their points, and of a pale green colour; the filaments are five, slender, short, and the antheræ large, and yellow; the style is shorter than the stamina; the stigma is round, and the germen oval. It is a native of South America, and flowers in August and September. The plant was introduced into the royal garden at Kew in 1778, by Monsieur Thouin, and under the direction of Mr. Aiton it acquired great vigour and luxuriance, extending its stalks fifteen feet in length; and, by means of slips obtained from it, two healthy young plants have since been produced: this circumstance is the more fortunate, as the parent plant lately died. Botanists have differed much respecting the officinal Jalap plant; Linnæus following Clusius, Plumier, Tournefort, and others, first referred it to the Mirabilis, but in the second edition of his Materia Medica

he adopts the opinions of Ray and Miller, in considering it a Convolvulus; and indeed after the account of this plant given by Dr. Houston, we are surprised that any doubt should still remain upon this subject.

It is said that the root of Jalap was first brought to Europe about the year 1610, and took its name from Xalapa, a province or town in New Spain. In the shops we find this root both cut into slices, and whole, of an oval shape, solid, ponderous, blackish on the outside, but grey within, and marked with several dark veins, by the number of which, and by its hardness, heaviness, and dark colour, the goodness of the root is to be estimated. It has scarcely any smell, and very little taste, but to the tongue and to the throat manifests a slight degree of pungency. The medicinal activity of Jalap resides principally, if not wholly, in the resin, which though given in small doses, occasions violent tormina. The gummy part bears an inconsiderable proportion to the resinous, and is found to have little or no cathartic power, but as a diuretic it is extremely active. That Jalap is an efficacious and safe purgative daily experience must evince, but according as the root contains more or less resin, its effects must of course vary. Hoffman thought it particularly improper and unsafe to administer this medicine to children; but Dr. Cullen observes, that if Jalap "be well triturated before exhibition with a hard powder, and the crystals of tartar are the fittest for the purpose, it will operate in lesser doses than when taken by itself, and at the same time very moderately and without griping."

[*Linn. Ray. North. Woodville.*

SECTION XX.

Aloes Tree.

Aloe Spicata.—SIBTHORP.

SEVEN species belong to this genus, some of them yielding a warm, purgative gum. The root of the species before us is perennial, strong, fibrous: the flower-stems rise three or four feet in height, and are smooth, erect, of a glaucous green colour, and towards the top beset with ovate bracteal scales: the leaves are numerous, and proceed from the upper part of the root: they are narrow, tapering, thick, or fleshy, succulent, smooth, glaucous, and

beset at the edges with spiny teeth: the flowers are produced in terminal spikes, and of a purple or reddish colour: there is no calyx: the corolla is monopetalous, tubular, nectariferous, cut into six narrow leaves which separate at the mouth: the filaments are six, tapering, yellowish, inserted into the receptacle, and furnished with oblong orange-coloured anthers: the germen is oblong, supporting a simple slender style, of the length of the filaments, and terminated by an obtuse stigma: the capsule is oblong and divided into three cells, with as many valves, and contains many angular seeds.

It is a native of Africa, and flowers most part of the year.

Not only the socotorine aloes, which is the inspissated juice of the plant here represented, but also the hepatic or Barbadoes aloes is directed for officinal use in our pharmacopœias. This however being obtained from another variety of the same species, viz. the aloe (a. *vera*) with thick denticulate spinous leaves, spotted on the surface, and shooting in every direction, we shall not particularly notice it. Besides, it appears probable from the observations of professor Murray, that different species as well as varieties of aloe would furnish the various kinds of this drug, and that Linnæus by referring these sorts to those plants, the recent juice of which seemed to respectively correspond the nearest to them in taste, might easily be misled; for Murray upon tasting the fresh juice of many different species of aloe, sometimes found it bitter, and at other times totally devoid of bitterness.

A tract of mountains about fifty miles from the Cape of Good Hope is wholly covered with the aloes plants, which renders the planting of them there unnecessary; but in Jamaica and Barbadoes they are now carefully cultivated; to the former of these islands, they were first brought from Bermuda, and gradually propagated themselves. They require two or three years standing before they yield their juice in perfection; to procure which, according to Dr. Browne, "The labourers go into the field with tubs and knives, and cut off the largest and most succulent leaves close to the stalk; these are immediately put into the tubs, and disposed one by the side of another in an upright position, that all the loose liquor may dribble out at the wound. When this is thought to be almost wholly discharged, the leaves are taken out one by one, passed through the hand to clear off any part of the juice that may yet adhere, or stick

in the less open veins; and the liquor put in shallow flat-bottomed vessels, and dried gradually in the sun, until it acquires a proper consistence. What is obtained in this manner is generally called *socotorine aloes*, and is the clearest and most transparent, as well as the highest in esteem and value." The method of procuring the common aloes he states to be nearly the same with that mentioned by Mr. Hughes, and lately by Mr. Millington: after a sufficient quantity of juice is drained from the leaves, to make it an object for the boiling house, the last-mentioned gentleman informs us, "three boilers, either of iron or copper, are placed to one fire, though some have but two, and the small planters only one. The boilers are filled with juice, and as it ripens or becomes more inspissated, by a constant but regular fire, it is ladled forward from boiler to boiler, and fresh juice is added to that farthest from the fire, till the juice in that nearest to the fire (by much the smallest of the three, and commonly called by the name of tatch, as in the manufactory of sugar) becomes of a proper consistency to be skipped or ladled out into gourds, or other small vessels, used for its final reception. The proper time to skip or ladle it out of the tatch, is when it is arrived at what is termed a resin height, or when it cuts freely, or in thin flakes from the edges of a small wooden slice, that is dipped from time to time into the tatch for that purpose. A little lime-water is used by some aloe boilers during the process, when the ebullition is too great." He adds, "as to the sun-dried aloes which is most approved for medicinal purposes, very little is made in Barbadoes. The process is however very simple, though extremely tedious. The raw juice is either put into bladders, left quite open at top, and suspended in the sun, or in broad shallow trays of wood, pewter, or tin, exposed also to the sun every dry day, until all the fluid parts are exhaled, and a perfect resin formed, which is then packed up for use, or for exportation."

These accounts of procuring the aloes differ considerably from that given by Dr. Wright, who says, "Hepatic aloes is obtained in the following manner. The plant is pulled up by the roots and carefully cleansed from earth or other impurities. It is then sliced and cut in pieces into small hand-baskets or nets. These nets or baskets are put into large iron boilers with water, and boiled for ten minutes, when they are taken out, and fresh parcels supplied till the

liquor is strong and black. At this period the liquor is thrown through a strainer into a deep vat, narrow at bottom, to cool, and to deposit its fæculent parts. Next day the clear liquor is drawn off by a cock, and again committed to the large iron vessel. At first it is boiled briskly, but towards the end the evaporation is slow, and requires constantly stirring to prevent burning. When it becomes of the consistence of honey, it is poured into gourds or calabashes for sale. The socotorine aloes may be prepared as above."

The aloe socotorina or socotorine aloes is so named, from being formerly brought from the island Socotria or Zocotria at the mouth of the Red Sea: it comes wrapt up in skins and is of a bright surface, and in some degree pellucid; in the lump of a yellowish red colour with a purplish cast; when reduced into powder, of a golden colour. It is hard and friable in the winter, somewhat pliable in the summer, and softens between the fingers. Its bitter taste is accompanied with an aromatic flavour, but not sufficient to prevent its being disagreeable: the smell is not very unpleasant, and somewhat resembles that of myrrh. The aloe hepatica and barbadensis, the Hepatic, Barbadoes, or common aloes, is chiefly brought from Barbadoes; the best sort in large gourd shells, an inferior kind in pots, and a still worse in casks; is darker coloured than the foregoing, and not so clear or bright. It is generally drier and more compact, though sometimes, especially the cask sort, quite soft and clammy. Its smell is much stronger and more disagreeable: the taste intensely bitter and nauseous, with little or nothing of the aromatic flavour of the socotorine.

Another kind of aloes obtained from the *aloe guineensis caballina*, which is also kept in the shops, and called aloe caballina, or horse aloes. This is easily distinguished from both the foregoing, by its strong rank smell: in other respects it agrees pretty much with the hepatic, and is now not unfrequently sold in its place. Sometimes it is prepared so pure and bright as scarcely to be distinguishable by the eye, even from the socotorine, but its offensive smell readily betrays it; and if this also should be dissipated by art, its wanting the aromatic flavour of the finer aloes will be a sufficient criterion. This aloe is not admitted into the Materia Medica, and is employed chiefly by farriers.

All the kinds of aloes consists of a resin united to a gummy mat-

ter, and dissolve in pure spirit, proof spirit, and proof spirit diluted with half its weight of water; the impurities only being left. They dissolve also by the assistance of heat in water alone; but as the liquor grows cold, the resinous parts subside.

The hepatic aloes is found to contain more resin and less gum than the socotorine, and this than the caballine. The resins of all the sorts, purified by spirit of wine, have little smell: that obtained from the socotorine has scarce any perceptible taste; that of the hepatic, a slight bitterish relish; and the resin of the caballine, a little more of the aloetic flavour. The gummy extracts of all the sorts are less disagreeable than the crude aloes: the extract of socotorine aloes has very little smell, and is in taste not unpleasant: that of the hepatic has a somewhat stronger smell, but is rather more agreeable in taste than the extract of the socotorine: the gum of the caballine retains a considerable share of the peculiar rank smell of this sort of aloes, but its taste is not much more unpleasant than that of the extracts made from the two other sorts.

Aloes is neither noticed by Hippocrates nor Theophrastus, but Dioscorides mentions two kinds; and Avicenna tells us, that of the different kinds the socotorine is the best. Celsus, however, who frequently employed aloes, does not mention any peculiar sort.

Aloes is a well known purgative; a property which it possesses not only when taken internally, but also by external application. This cathartic quality of aloes does not, like most of the others of this class, reside in the resinous part of the drug but in the gum, for the pure resin has little or no purgative power. Boerhaave declares aloes to be an effectual and safe cathartic, but though we may have little to fear from its hypercathartic effects, yet in large doses it often produces much heat and irritation, particularly about the rectum, from which it sometimes occasions a bloody discharge: therefore, to those who are subject to piles, or of an hemorrhagic diathesis, or even in a state of pregnancy, its exhibition has been productive of considerable mischief: but on the contrary, by those of a phlegmatic constitution, or suffering by uterine obstructions, and in some cases of dyspepsey, palsy, gout, and worms, aloes may be employed as a laxative with peculiar advantage. Its purgative effects are not always in proportion to the quantity taken, and as its principal use is rather to obviate costiveness than to operate strong-

ly, this ought to be no objection to its use. Respecting the choice of the different kinds of aloes, it may be observed that the socotorine, as already mentioned, contains more gummy matter than the hepatic, and hence is found to purge with more certainty and greater irritation; therefore is most proper where a stimulus is required, or for promoting the uterine discharge; while the hepatic is better calculated for the purpose of a common purgative; and also by containing more resin answers better for external application considered as a vulnerary.

A full description of this plant is given in Dr. Edward Smith's edition of Sibthorp's superb Flora Græca. Sibthorp asserts, that the aloe vulgaris, or common Barbadoes aloes, is the true Αλόη of Dioscorides, and in every respect resembles the Barbadoes aloes as described by Sloane in his History of Jamaica.

[*Dioscor. Sloane. Woodv. Powell.*

SECTION XXI.

Rhubarb.

Rheum Palmatum.—WILDEN.

THE rheum or rhubarb genus has eight species, as follows, all of which are actively or slightly aperient.

1. R. rhaponticum. Common rhubarb, a native of Thrace.
2. R. palmatum. Palmate-leaved, or true Chinese rhubarb.
3. R. undulatum. Wave-leaved Chinese rhubarb.
4. R. compactum. Thick leaved or compact rhubarb, a native of Tartary.
5. R. ribes. Wasted-leaved Persian rhubarb.
6. R. Tartaricum. Tartarian or heart-leaved rhubarb.
7. R. hybridum. Hybrid rhubarb, a native of Asia.
8. R. leucorrhizum. A native of Siberia.

The officinal rhubarb is the species named in the second of these. The root is perennial, thick, of an oval shape, and sends off long tapering branches; externally it is brown, and internally of a deep yellow colour: the stalk is erect, round, hollow, jointed, sheathed, slightly scored, branched towards the top, and rises to the height of six or eight feet: the radical leaves are numerous, large, rough, of a roundish figure, and deeply cut into lobes, and irregularly pointed

segments, and stand upon long smooth round footstalks: the leaves which proceed from the stalk are placed at the joints, which they supply with membranous sheathes, and are successively smaller towards the upper part of the stem: the flowers terminate the branches, which they surround in numerous clusters, forming a kind of spike, and appear in April and May: the corolla divides into six obtuse segments, which are of a greenish white colour, and alternately smaller: the calyx is wanting: the filaments are nine, slender, about the length of the corolla, and furnished with oblong double antheræ: the style is very short, and terminated by three reflected stigmata: the germen becomes a triangular seed, with membranous margins of a reddish colour. It is a native of Tartary in Asia.

It was not until the year 1732 that naturalists became acquainted with any plant which seemed to afford the rhabarbarum officinale *, when some plants, received from Russia by Jussieu at Paris, and Rand at Chelsea †, were said to supply this important desideratum, and as such were adopted by Linnæus, in his first edition of the Species Plantarum, under the name of Rheum Rhabarbarum. This however was not very generally received as the genuine rhubarb plant; and with a view to ascertain this matter more completely, Kauw Boerhaave procured from a Tartarian rhubarb merchant the seeds of those plants, whose roots he annually sold, and which were admitted at Petersburgh to be the true rhubarb: these seeds were soon propagated, and were discovered by De Gorter to produce two distinct species, viz. the R. rhabarbarum of Linnæus, or as it has since been called R. undulatum, and another species, a specimen of which was presented to Linnæus, who declared it to be a new one, and was first mentioned in the second edition of the Sp. Plantarum in 1762, by the name of R. palmatum. Previous to this

* The rheum rhaponticum of Linnæus, or rhaponticum folio lapathi majoris glabro of C. Bauhin, is generally supposed to be the rhabarbarum of the ancients; "Alpinus aliique putant esse Ρᾶ vel Ρῆον veterum, cujus radicem usur (Vide Dioscorid. Mat. Med. lib. 3, cap. 2.) Ipse Alpinus sibi circa annum 1610, stirpem ex Thracia procuravit, et hæc Patavio Venetiam primo, dein inde in Angliam ad Parkinsonium (Theat. Bot. p. 157.) devenit." Murray Ap. Med. vol. iv. 354. It is well known that the ancient rhubarb had not the purgative power of the modern.

† Seeds of this species were also sent to Miller from Boerhaave, at Leyden, by the title of "Rhabarbarum verum Chinense." See his Gard. Dict.

time, De Gorter had repeatedly sent its seeds to Linnæus *, but the young plants which they produced constantly perished: at length he obtained the fresh root, which succeeded very well at Upsal, and afterwards enabled the younger Linnæus to describe this plant †, ann. 1767. But two years antecedent to this, Dr. Hope's account of the rheum palmatum, as it grew in the botanic garden near Edinburgh, had been read before the Royal Society at London; and of the great estimation in which this plant was held by him, we have the following proof: "From the perfect similarity of this root with the best foreign rhubarb in taste, smell, colour, and purgative qualities, we cannot doubt of our being at last possessed of the plant which produces the true rhubarb, and may reasonably entertain the agreeable expectations of its proving a very important acquisition to Britain." But from the relation we have given, it appears that the seeds of both R. undulatum and R. palmatum, were transmitted to Petersburgh, as those of the true rhubarb: we are therefore to conclude, that the former species has an equal claim to this importance with the latter; and from further inquiries made in Russia, there is the best authority for believing that the R. compactum also affords this very useful drug. The seeds of the rheum palmatum were first introduced into Britain in 1762, by Dr. Mounsey, (who sent them from Russia) and were supposed to be a part of those already mentioned; and since their prosperous cultivation by the late professor of botany at Edinburgh, the propagation of this plant has been gradually extended to most of our English gardens, and with a degree of success which promises in time to supersede the importation of the foreign root.

Two sorts of rhubarb roots are usually imported into this country for medical use, viz. The Chinese ‡, and the Turkey rhubarb §; the

* See the letters between De Gorter and Linnæus, by Nozeman, in Verhandelingen van het Genootschap to Rotterdam, vol. i. p. 455, and cited by Murray.

† Vide Plant. rarior. hort. Upsal. fasc. 1.

‡ Colitur hoc a Chinensibus, præcipue in provincia Xensi sub nomine Taihoang, Bergius, M. M. p. 332.

§ "Olim, quum commercium in orientalibus regionibus per Natoliam fieret, Rhabarbarum ex portibus Turcicis ad Europæas transferebatur, unde nomen Rhabarbari Turcici." Murray, l. c. Mr. Bell (in his Travels from St. Petersburg to divers parts of Asia) says, that the best rhubarb grows plentifully on a

first is in oblong pieces, flattish on one side, and convex on the other; compact, hard, heavy, internally of a dull red colour, variegated with yellow and white, and when recently powdered appears yellow, but on being kept becomes gradually redder. The second is the most valuable, and is brought to us in roundish pieces, with a large hole through the middle of each; it is more soft and friable than the former sort, and exhibits, when broken, many streaks of a bright red colour. "The marks of the goodness of rhubarb are, the liveliness of its colour when cut; its being firm and solid, but not flinty or hard; its being easily pulverable, and appearing when powdered of a fine bright yellow colour; its imparting to the spittle, when chewed, a deep saffron tinge, and not proving slimy or mucilaginous in the mouth; its taste is subacrid, bitterish, and somewhat styptic; the smell lightly aromatic."

The purgative qualities of rhubarb are extracted more perfectly by water than by rectified spirit: the root remaining after the action of water is almost if not wholly inactive; whereas after repeated digestion in spirit, it proves still very considerably purgative. The virtue of the watery infusion, on being inspissated by a gentle heat, is so much diminished, that a dram of the extract is said to have scarcely any greater effect than a scruple of the root in substance; the spirituous tincture loses less; half a dram of this extract proving moderately purgative. "The qualities of this root are that of a gentle purgative, and so gentle, that it is often inconvenient by reason of the bulk of the dose required, which in adults must be from half a dram to a dram. When given in a large dose, it will occasion some griping, as other purgatives do; but it is hardly ever heating to the system, or shews the other effects of the more drastic

long chain of mountains in Tartary, which extend from Selin to the lake Kokonor near Tibet. At a proper age the roots are taken up, which, according to Pallas, is in April or May; but in Bell's account, this is said to be done in the autumn: they are then to be cleaned, the smaller branches cut off, and the larger roots divided into pieces of a proper size; after this they are perforated and suspended to dry either upon the neighbouring trees, or in tents, or as some have reported, to the horns of sheep. The proper exsiccation of this root is certainly attended with considerable difficulty, and the cultivators of rhubarb in this country have not yet agreed in what mode this is to be best accomplished. The recent root in this process, according to the experiment of Sir William Fordyce, loses nearly nine-tenths of its weight." See Trans. of the Society for Encouragement of Arts, &c.

purgatives. The purgative quality is accompanied with a bitterness, which is often useful in restoring the tone of the stomach when it has been lost; and for the most part its bitterness makes it sit better on the stomach than many other purgatives do. Its operation joins well with that of neutral laxatives; and both together operate in a lesser dose than either of them would do singly.

"Some degree of stipticity is always evident in this medicine, and as this quality acts when that of the purgative has ceased, so in cases of diarrhœa, when any evacuation is proper, rhubarb has been considered as the most proper means to be employed. I must however remark here, that in many cases of diarrhœa, no further evacuation than what is occasioned by the disease is necessary or proper.—The use of rhubarb in substance for keeping the belly regular, for which it is frequently employed, is by no means proper, as the astringent quality is ready to undo what the purgative had done; but I have found that the purpose mentioned may be obtained by it, if the rhubarb is chewed in the mouth, and no more is swallowed than what the saliva has dissolved. And I must remark in this way employed it is very useful to dyseptic persons. Analagous to this, is the use of rhubarb in a solution, in which it appears to me that the astringent quality is not so largely extracted as to operate so powerfully as when the rhubarb was employed in substance."

[*Wilden. Woodv. Murray. Linn.*

SECTION XXII.

Ipecacuan.

Callicocea Ipecacuanha.—SCHREBER.

THE plant from which this valuable root is obtained was till lately unknown, notwithstanding that the drug has been in common use for considerably more than a century. It has been referred to several different genera, as those of Paris, euphorbia, conicera, viola, psycotria; Mutis and the younger Linnæus ascribed it to the last of these. Schreber asserted it to be the root of a small plant which he denominates Callicocca, a native of Brazil, and belonging to Jussieu's order of rubiaceæ. Woodville leaves the question undecided, and gives it no reference whatever. Schreber has now been ascertained to be correct. The plant was first accurately figured and described in Vol. 6 of the Transactions of the Linnæan Society

by Professor Brotero of Coimbra, from observations made on living specimens in Brazil, by Dr. Gomes, and from dried specimens sent to Europe.

Piso divides this root into two sorts, the white and the brown, or according to Geoffroy, the Peruvian and Brazilian ipecacuanha *; but three sorts are evidently distinguishable in our shops, viz. ash-coloured or grey, brown, and white.

The ash-coloured is brought from Peru, and " is a small wrinkled root, bent and contorted into a great variety of figures, brought over in short pieces full of wrinkles and deep circular fissures, down to a small white woody fibre that runs in the middle of each piece: the cortical part is compact, brittle, looks smooth and resinous upon breaking: it has very little smell; the taste is bitterish and subacrid, covering the tongue as it were with a kind of mucilage. The brown is small, somewhat more wrinkled than the foregoing; of a brown or blackish colour without, and white within; this is brought from Brazil. The white sort is woody, has no wrinkles, and no perceptible bitterness in taste. The first, the ash-coloured or grey ipecacuan, is that usually preferred for medicinal use. The brown has been sometimes observed, even in a small dose, to produce violent effects. The white, though taken in a large one, has scarce any effect at all †." Dr. Irving has ascertained by experiments ‡, that this root contains a gummy and resinous matter, and that the gum is in much greater proportion, and is more powerfully emetic than the resin: that the cortical part is more active than the ligneous, and that the whole root manifests an antiseptic and astringent power. He also found its emetic quality to be most effectually counteracted by means of the acetous acid, insomuch, that thirty grains of the powder taken in two ounces of vinegar, produced only some loose stools.

The first account we have of ipecacuan is that published by Piso, in 1649; but it did not come into general use till thirty years afterwards, when Helvetius §, under the patronage of Louis XIV. employed it at the Hotel de Dieu, and introduced this root into com-

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* Pison. ind. res. Med. et Nat. p. 231.

† Edinb. New Dispens. p. 211.

‡ See the Dissertation which obtained the prize medal of the Harveian Society of Edinburgh, for 1784.

§ See Recueil des Methodes, p. 280.

mon practice; and experience has proved it to be the mildest and safest emetic with which we are acquainted, having this peculiar advantage, that if it does not operate by vomit, it readily passes off by the other emunctories.

It was first introduced to us with the character of an almost infallible remedy, in dysenteries and other inveterate fluxes, as diarrhœa, menorrhagia, and leucorrhœa, and also in disorders proceeding from obstructions of long standing; nor has it lost much of its reputation by time. The use of ipecacuan in these fluxes is thought to depend upon its restoring perspiration; for in these cases, especially in dysentery and diarrhœa, the skin is dry and tense; and while the common diaphoretics usually pass off by stool, small doses of this root have been administered with the best effects, proving both laxative and diaphoretic *. In the spasmodic asthma, Dr. Akenside † remarks, that where nothing contraindicates repeated vomiting, he knows no medicine so effectual as ipecacuan. In violent paroxysms a scruple procures immediate relief. Where the complaint is habitual, from three to five grains every morning, or from five to ten every other morning, may be given for a month or six weeks.

This medicine has also been successfully used in hemorrhages ‡. Several cases of menorrhagia are mentioned by Dahlberg §, in which one-third or half a grain was given every four hours till it effected a cure. These small doses are likewise found of great use in catarrhal and even consumptive cases, as well as in various states of fever. Dr. Cullen informs us ‖, that he knew a practitioner who cured intermittents by giving five grains of ipecacuanha, or enough to excite nausea, an hour before the accession of the fit was expected; and that Dr. Thompson, formerly of Montrose, proposed to cure agues by the employment of emetics given at the time of accession, or at the end of the cold stage: and this practice has also been successful, and may indeed be executed by tartar emetic; but in trying

* Dr. Cullen attributes its good effects entirely to its purgative quality, M. M. vol. ii. p. 477.

† Med. Trans. vol. i. p. 96.

‡ See Gianella de admirabili Ipec. virtute in curandis febribus. Patav. 1754. Also Bergius (M. M. p. 103.) and others.

§ Vet. Acad. Handl. vol. xxxi. p. 316. a 1770.

‖ L. c.

such practices, I have found, says he, the ipecacuanha more manageable than the other, and generally to be more easy to the patient."

Ipecacuan, particularly in the state of powder, is now advantageously employed in almost every disease in which vomiting is indicated; and when combined with opium, under the form of pulvis sudorificus, it furnishes us with the most useful and active sweating medicine which we possess. It is also given with advantage in very small doses even when it produces no sensible operation. The full dose of ipecacuan in substance is a scruple, though less doses will frequently produce an equal effect.

[*Schreber. Piso. Trans. Lin. Soc.*

SECTION XXIII.

Bitter Apple, Cucumber, or Colocynth.

Cucumis Colocynthis.

THE colocynth, or coloquintida, is a species of cucumber. The root is annual, white, divided into long branches, which strike deeply into the ground; the stems trail, like those of the garden cucumber, a considerable length, and are beset with rough hairs: the leaves are of a triangular shape, obtuse, variously situated, hairy, on the upper surface of a fine green, beneath rough, and whitish; the flowers are yellow, solitary, and appear at the axillæ of the leaves; the calyx of the male flowers is bell-shaped, and divided at the brim into five tapering segments; the corolla is monopetalous, bell-shaped, and divided at the limb into pointed segments; the filaments are three, two of which are bifid at the apex; they are all very short, and inserted into the calyx; the antheræ are linear, long, erect, and adhere together on the outer side; the calyx and corolla of the female flower are similar to those of the male; the three filaments are without antheræ: the germen is large; the style cylindrical, very short, furnished with three stigmata, which are thick, gibbous, bifid, and bent outwardly; the fruit is a round apple, of the size of an orange, divided into three cells, abounding with a pulpy matter, separated every where by cellular membrane, and including many ovate compressed seeds. The flowers appear from May till August.

Colocynth is imported for use to this part of Europe from Tur-

key, but it is yet unknown here of what place this plant is a native. It seems to have been cultivated in Britain in the time of Turner, and the figure given in Woodville was drawn from a specimen of the plant produced by sowing the seed in a hot-bed. Though the plants thus raised put forth flowers readily, they are very rarely known to bear fruit. The spongy membranous medullary part of the fruit is directed for medicinal use: this, "which to the taste is nauseous, acrid, and intensely bitter, on being boiled in water, renders a large quantity of the liquor ropy and slimy; even a tincture of it made in proof spirit is so glutinous as not to pass through a filter, and not easily through a common strainer. The watery decoctions inspissated, yield a large proportion, half of the weight of the colocynth, or more, of a mucilaginous extract; which purges strongly, but with much less irritation, and greater safety, than the colocynth itself, and appears to be the best preparation obtainable from this drastic drug."

This very powerful and irritating cathartic is the Κολοκυνθις of the ancient Greeks, and the Alhandal of the Arabians. It was frequently employed by both in different diseases, though not without an apprehension of danger, from the violence of its effects, of which various instances are related. In doses of ten or twelve grains this substance purges with great vehemence, frequently producing violent gripes, bloody discharges, and even disordering the whole system. Many attempts, therefore, have been made to correct its virulence, by the addition of acids, astringents, and the like; but these seem to answer no other purpose than what might be equally effected by a reduction of the dose. "The best method of abating its virulence, without diminishing its purgative virtue, seems to be by triturating it with gummy farinaceous substances, or the oily seeds, which, without making any alteration in the colocynth itself, prevents its resinous particles from cohering, and sticking upon the membranes of the intestines, so as to irritate, inflame, or corrode them.

This drastic purgative has been recommended in various chronic complaints; but as several other catharties have all the advantages of coloquintida, and may be used with more safety, its use is now seldom resorted to, especially alone.

[*Lewis. Woodville. Schulz.*

SECTION XXIV.

Columbo.

Calumbă.—PHARM. LOND.

THE name of columbo-root seems to have had its origin in the supposition that it was brought to us from Ceylon: a supposition strengthened by its possessing the name of the principal town in that island. It being a staple export of the Portuguese, the place of growth was carefully concealed, and the plant itself unknown to botanists till very lately, when it was raised at Madras from a root brought to Dr. James Anderson of that place, from Mozambique. From a drawing in the possession of the Linnæan Society, the plant appears to belong to the natural order *monospermum*; but the genus cannot yet be determined, in consequence of the female flower not having hitherto been seen. It is brought from Columbo in knobs or circular pieces, brown, and wrinkled on the outer surface, yellowish within, and consisting of cortical, woody, and medullary lamina. Its smell is aromatic; its taste is pungent, and nauseously bitter.

Practitioners in the East Indies first borrowed the use of this root from the natives of those countries where it is produced, and found it of great service in most disorders of the stomach and bowels, and especially in the cholera, so fatal in hot climates. It stopped the vomiting in this complaint, more speedily and effectually than any other medicine; an effect attributed to its property of correcting the putrid disposition of the bile. With this intention its use has been recommended by Dr. Percival; and it has been successfully used in this country, not only in bilious complaints, but in various cases of dyspepsia.

We have given the botanical name with the spelling of the London College, who have changed Columba into Calumba. We see, however, no reason for this: Columbo is the usual pronunciation and orthography of the Ceylonese capital; and to depart from this mode is to make an unnecessary deviation from the established chemical terms, derived from the same quarter, *Columbium*, and *Columbite*.

[*Trans. Lin. Soc. Powell. Editor.*

SECTION XXV.

Cardamom Tree.

Elitharia Cardamomum.—MATON.

THIS has hitherto been regarded as a species of Amomum, distinguished by the trivial name of *repens*; to which genus the ginger * and grains of Paradise plants were also referred. From an accurate description, however, of the plant producing this valuable aromatic, communicated to the Linnæan Society by Mr. White, surgeon of Madras, who has nevertheless persevered in the common error of regarding it as an amomum, Dr. Maton has arranged it as a new genus, to which he has given the name of Eletharia, from the appellation of Elethari, originally bestowed upon this tribe by Van Rhaede in his Hortus Malebaricus.

The root is perennial: the stalks are simple, sheathy, erect, grow to a considerable height, and beset with leaves, which are lance-shaped, large, entire, acutely ribbed, and stand alternately upon the sheaths of the stalk: the flower stalk proceeds immediately from the root, and creeps along the ground; it is commonly about a foot and a half in length, articulated, in a zig-zag form, and producing numerous flowers, which are placed upon divided stipulated peduncles, arising from the articulations: the calyx is small, and obscurely divided into three teeth at the margin: the corolla is monopetalous, composed of a narrow tube, divided at the mouth into four segments; of these the three outermost are long, narrow, uniform, and of a straw colour, but the central one, which has been considered as a nectary, is large, broad, concave, of an irregular oval shape, and marked with violet coloured stripes: the filament is membranous, strap-shaped, shorter than the segments of the corolla, to the top of which the anthera is joined: the germen is roundish, and placed below the insertion of the tube of the corolla: the style is filiform, of the length of the filament, and supplied with an obtuse stigma: the capsule is triangular, divided into three cells and valves, containing several small dark coloured seeds.

This plant is a native of the East Indies, and according to Sonne-

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* See ch. iv. sect. xviii.

rat grows abundantly on the Malabar coast: it differs considerably from the Amomum Cardamomum of Linnæus, as appears by the specific character he has given it, and the figures to which it is referred to in his Species Plantarum. Sonnerat, who first discovered the Amomum repens, and on whose authority it is considered to afford the seeds officinally known by the name of Cardamomum minus, informs us, that this plant abounds so plentifully on a certain mountain on the coast of Malabar, that it is called the Mountain of Cardamoms, from which all India is supplied with the seeds.

The Cardamons imported into Europe have been distinguished by the names Cardamomum majus, medium, and minus; the distinction depending upon the respective sizes of their seeds; but the different species from which the two former are said to have been produced, are so imperfectly described, and their botanical histories so confused, that we are unable to give any satisfactory information concerning them; and whether the *Amomum verum* of the ancient Greek writers is referable to our cardamom, seems also equally uncertain.

The seeds of the cardamomum minus, which are now generally preferred for medicinal purposes, are brought to us in their capsules, or husks, by which they are preserved; for they soon lose a part of their flavour when freed from this covering. "Their virtue is extracted not only by rectified spirit, but almost completely by water also; with this difference, that the watery infusion is cloudy or turbid, the spirituous clear and transparent. Scarcely any of the aromatic seeds give out so much of their warmth to watery menstrua, or abound so much with gummy matter, which appears to be the principle by which the aromatic part is made dissoluble in water: the infusion is so mucilaginous, even in a dilute state, as hardly to pass through a filter."

"In distillation with water a considerable quantity of essential oil separates from the watery fluid, of a pale yellowish colour, in smell exactly resembling the Cardamoms, and of a very pungent taste: the remaining decoction is disagreeably bitterish, and mucilaginous. On inspissating the tincture made of rectified spirit, a part of the flavour of the Cardamoms arises with the spirit; but the greatest part remains behind, concentrated in the extract, which smells moderately of the seeds, and has a pungent aromatic taste,

very durable in the mouth, and rather more grateful than that of the seeds in substance."

Cardamom seeds, on being chewed, impart a glowing aromatic warmth, and grateful pungency: they are supposed gently to stimulate the stomach, and prove cordial, carminative, and antispasmodic, but without that irritation and heat which many of the other spicy aromatics are apt to produce. We are told by Sonnerat, that the Indians use it much, and believe it to strengthen the stomach, and assist digestion. Physicians however consider Cardamoms merely as an aromatic, and prescribe them in conjunction with other medicines, which they are intended to correct or assist.

[*Trans. Lin. Soc. Sonnerat. Woodville. Lewis.*

SECTION XXVI.

Gum ammoniac Plant.

Heracleum gummiferum.—WILDEN.

THOUGH we have assigned the gum ammoniac tree to this genus of Mr. Wildenow, originally known by the name of Cowparsnip; there is still a doubt upon the subject. The plant described for the first time in the Hortus Berolinensis * of this author was raised by him in the Royal Garden at Berlin from Seeds, taken out of the ammoniacum of the shops, which, it is well known, often contains them. Dr. Wildenow declares himself to be satisfied, that this is the source of this valuable drug, though he has not been able to obtain it from the plant thus produced; and the seeds employed may therefore have belonged to another tribe.

Woodville does not pretend to appropriate it; and only speaks of it as follows, "This concrete gummy-resinous juice is composed of little lumps, or tears, of a milky whiteness: the external parts of the mass are yellowish or brownish, and the white tears change to the same colour on being exposed for some time to the air.

We have hitherto had no information concerning the plant which produces this drug, nor of the manner in which it is obtained: judging however from the seeds and pieces of an umbelliferous plant, with which it is often intermixed, there is no doubt of its being the produce of a vegetable of this kind: and as ammoniacum

* Tom. i, Pl. 53, 54.

is very analogous to galbanum, the former, as well as the latter, is probably procured from a species of the Bubon. According to the ancient account of this drug, it was produced in the west of Egypt, where the famous temple of Jupiter Ammon formerly stood, now the kingdom of Barca. At present it is brought here from Turkey, and from the East Indies.

Ammoniacum has a strong and somewhat ungrateful smell, and a nauseous sweetish taste, followed by bitterness, Its effects are similar to those of galbanum, or rather of assafœtida, but it has been generally preferred to either of these for resolving obstructions of the lungs; hence it is chiefly employed in asthmas and difficulty of expectoration. In large doses it opens the bowels.

[*Wildenow. Woodville. Powell.*

SECTION XXVII.

Oil of Cajuput-tree.

Melaleuca Cajuputi.

THE genus from which this elegant aromatic is obtained, is decisively settled; but there is still some doubt as to the species. By Linnéus and his son it was referred to Melaleuca Leucadendron, and their authority has had an extensive influence. This tree observes Dr. Woodville, rises with a long flexible trunk, sending off irregular ascending branches, covered with a pale thick lamellated tough bark. Leaves linearly-lanceolate, entire, smooth, dense, five-nerved, ash coloured, odorous, alternate, on short footstalks, Flowers white, sessile, in long subterminal spikes. Bracts floral. minute, ovate, pointed. Calyx tubular, five parted, deciduous, of a brownish red. Corol of five petals, roundish, concave, much longer than the calyx. Filaments about forty, united at the base in five or six bundles, long, capillary, unequal, inserted in the tube of the calyx, and furnished with small ovate incumbent antheræ. Germ below, roundish. Style filiform, somewhat swelled at the stigma. Capsule roundish, three celled, three valved, opening at the apex, and half inclosed by the calyx. Seeds numerous, oblong small, compressed, angular.

It is a native of India, where it commonly grows in the woods: a very perfect botannical specimen of it is to be found in the herbarium of Sir Joseph Banks. The narrow leaved

variety of this species was introduced into the royal garden at Kew, in 1775, from New Caledonia, by J. R. Forster, L.L.D.

The origin of cajeput oil, or the vegetable from which it is obtained, was long unknown, and continued a matter of conjecture. As this essential oil is said to be somewhat similar in flavour and odour to the cardamom, an opinion very generally prevailed, that it was procured from a species of it. It is now however clearly proved to be derived from the Melaleuca Leucadendron, as observed by Linnæus in 1772, and since confirmed by his son in the supp. plant.

Dr. Powell however, the translator of the recent London Pharmacopœia, observes that "it appears from specimens of the tree yielding the true cajuputi, sent home by Mr. Christopher Smith, that the species is different, and referable to table 17 of Tomkins's Herbarium ambrinense, Vol. II, and not to the author's *arbor alba*, table 16. After a careful examination of specimens in Sir Joseph Banks's and other collections by Dr. Maten, and of these in the Linnéan *Herbarium* by Dr. Smith, we are authorized to consider the tree which yields the above oil, as a new species; and from the name of its medicinal product, those gentlemen have agreed to give to it the appellation of M. Cajuputi."

That the leaves of this tree have an aromatic odour, resembling that of cardamom seed, and afford, by distillation, a fragrant essential oil, manifesting this aromatic principle still more strongly, is asserted by Valentyn and Rumphius; but as they called the oil by no peculiar name, it was not recognized as the cajeput oil until some of these leaves were sent to Amsterdam, where, upon being subjected to distillation, an oil was obtained, agreeing, in every respect, with that of the best cajeput *. This essential oil appears to be lodged in the minute glands or vesicles of the leaves, analogously to that of the hypericum perforatum †.

Cajeput oil, (called also Oleum Wittnebianum, from Wittneben, who gave an account of the process for obtaining it,) though un-

* Vide *Nieuwe vaderlandsche Letter-Oeffningen. P.* 3. *n.* 3. *bladz:* 104.

† The leaves of this melaleuca, according to De Loureiro, are an useful medicine; he says, they are "attenuant, strengthening, stomachic, diuretic, emmenagogue, and of service in obstructions of the liver, dropsy, debility of the stomach, and dyspnœa.

known in Britain, is now admitted into the Materia Medica of all the principal foreign pharmacopœias.

It is imported into Europe from the East Indies, and is distilled chiefly in the island of Banda. Thunberg * says that it has the appearance of an inflamable spirit, of a green colour, and so completely volatile that it evaporates entirely, leaving no residuum; its odour is of the camphoraceous kind, with a terebinthinate admixture: when it is applied to the nostrils copiously, its smell is at first ungrateful, but in a small quantity, or at a distance, its odour is very agreeable. Goetz, † on the contrary, says it is limpid, or rather yellowish, and that on being kept in a vial not closely corked, it diffuses at first a pleasant odour, which gradually changes to one somewhat like that of turpentine, and at length becomes similar to that of savine. Its taste, he says, is aromatic, and approaching to that of the oil of rosemary. A single drop, applied to the temples, produces a peculiar sensation in the interior canthus of the eyes, and excites tears, which he considers as the most certain criterion of the genuineness of the oil. From its exorbitant price it is frequently adulterated, and therefore is seldom found in perfect purity in Europe.

Cajeput oil appears to be a powerful medicine, and is much esteemed in Germany, as well as in India, in the character of a general remedy in chronic and painful complaints; it is used for the same purposes for which we employ the officinal ethers, to which it seems to have a considerable affinity; the cajeput however is more potent and pungent: taken into the stomach, in the dose of five or six drops, it heats and stimulates the whole system, proving at the same time a very certain diaphoretic, by which probably the good effects it is said to have in dropsies and intermittent fevers, are to be explained. For its efficacy in various spasmodic and convulsive affections, it is highly esteemed; and numerous instances of its successful employment are published by different authors ‡. It has been also used both internally and externally with much advantage in several other obstinate disorders, as palsy, hypochondrical and hysterical affections, deafness, defective vision, tooth-ach, gout,

* In *Vet. Acad. Handl.* 1782. *p.* 223. † *Comm. Nor.* 1731. *p.* 5.

‡ These are respectively cited by Murray, to whose work we refer those readers who wish for a fuller account of this article.

rheumatism, menstrual obstructions, herpetic eruptions, &c. of which Thunberg gives a particular relation *.

The dose is from two to six and even twelve drops.

SECTION XXVIII

Assa-Fœtida Plant.

Ferula assafœtida.—WILD.

THE ferula or fennel genus comprises nine or ten known species, of which the assafœtida is one, though there is a doubt as to which and it is ingeniously conjectured by Sir Joseph Banks, that this powerful and offensive gum-resin is yielded by several of them. Though Assafœtida was formerly in great estimation, both as a medicine and a sauce, yet we had no particular account of the plant till Kaempfer returned from his travels in Asia, and published his Amœnitates Exoticæ in the beginning of the present century. As he saw the plant growing, and describes it from his own observation, we have collected the following general description from the history he has given:

It is a native of Persia, the root is perennial, tapering, ponderous, and increases to the size of a man's arm or leg, covered with a blackish coloured bark, and near the top beset with many strong rigid fibres; the internal substance is white, fleshy, and abounds with a thick milky juice, yielding an excessively strong fetid alliaceous smell; the stalk is simple, erect, straight, round, smooth, striated, herbaceous, about six or seven inches in circumference at the base, and rises luxuriantly to the height of two or three yards, or higher †; radical leaves six or seven, near two feet long, bipinnated, pinnules alternate, smooth, variously sinuated, lobed, and sometimes lance-shaped, of a deep green colour, and fetid smell; the umbels are compound, plano-convex, terminal, and consist of many rays: the seeds are oval, flat, foliaceous, of a reddish brown colour, rough, marked with three longitudinal lines, have a porraceous smell, and

* *L. c:* The odour of cajeput oil is remarkably destructive to insects: a few drops, in a cabinet or drawer, wherein animal or vegetable specimens of natural history are kept in a dried state, have on this account been found very useful.

† *Caulis*, in orgyjæ, sesquiorgyjæ, vel majorem longitudinem luxuriosè exsurgens, crassite in imo quanta manus complexûm superat.

a sharp bitter taste; the petals Kaempfer did not see, but supposes them in number five, minute, and white.

This plant is said to vary much according to the situation and soil in which it grows, not only in the shape of the leaves, but in the peculiar nauseous quality of the juice which impregnates them; this becomes so far altered that they are sometimes eaten by the goats.

Assafœtida is the concrete juice of the root of this plant, which is procured in the following manner on the mountains in the provinces of Chorasaan and Laar in Persia. At that season of the year when the leaves begin to decay, the oldest plants are selected * for this purpose. First the firm earth which encompasses the root, is rendered light by digging, and part of it cleared away, so as to leave a portion of the upper part of the root above the ground; the leaves and stalk are then twisted off and used with other vegetables for a covering to screen it from the sun, and upon this covering a stone is placed to prevent the winds from blowing it down: in this state the root is left for forty days, after which the covering is removed, and the top of the root cut off transversely; it is then screened again from the sun for forty-eight hours, which is thought a sufficient time for the juice to exude upon the wounded surface of the root, when the juice is scraped off by a proper instrument, and exposed to the sun to harden: this being done, a second transverse section of the root is made, but no thicker than is necessary to remove the remaining superficial concretions which would otherwise obstruct the farther effusion of fresh juice; the screening is then again employed for forty-eight hours, and the juice obtained a second time, as before mentioned. In this way the Assafœtida is eight times repeatedly collected from each root; observing, however, that after every third section, the root is always suffered to remain unmolested for eight or ten days, in order that it may recover a sufficient stock of juice. Thus, to exhaust one root of its juice, computing from the first time of collecting it to the last, a period of nearly six weeks is required; when the root is abandoned, and soon perishes.

The whole of this business is conducted by the peasants who live in the neighbourhood of the mountains where the drug is procured;

* Radix quadrienniò minor parum lactescit et nunquam secatur.

and as they collect the juice from a number of roots at the same time, and expose it in one common place to harden, the sun soon gives it that consistence and appearance in which it is imported into Europe.

Assafœtida has a bitter, acrid, pungent taste, and is well known by its peculiar nauseous fetid smell, the strength of which is the surest test of its goodness; this odour is extremely volatile, and of course the drug loses much of its efficacy by keeping. According to Kæmpfer's account, the juice is infinitely more odorate when recent, than when in the state brought to us: Affirmare ausim, unam drachmam recens effusam, majorem spargere fætorem, quàm centum libras vetustioris quem siccum venundant aromatarii nostrates. "We have this drug in large irregular masses of a heterogeneous appearance, composed of various shining little lumps or grains, which are partly whitish, partly of a brownish or reddish, and partly of a violet hue. Those masses are accounted the best which are clear, of a pale reddish colour, and variegated with a great number of fine white tears. Assafœtida is composed of a gummy and a resinous substance, the first in largest quantity. Its smell and taste reside in the resin, which is readily dissolved and extracted by pure spirit, and, in a great part, along with the gummy matter, by water *."

Assafœtida is a medicine in very general use, and is certainly a more efficacious remedy than any of the other fetid gums: it is most commonly employed in hysteria, hypochondriasis, some symptoms of dyspepsia, flatulent colics, and in most of those diseases termed nervous: but its chief use is derived from its antispasmodic effects; and it is thought to be the most powerful remedy we possess for those peculiar convulsive and spasmodic affections which often recur in the first of these diseases, both taken into the stomach and in the way of enema. It is also recommended as an emmenagogue, anthelminthic, expectorant †, antiasthmatic, and anodyne. Where we wish it to act immediately as an antispasmodic, it should be used in a fluid form, as that of a tincture.

Dr. Hope has the credit of having first cultivated the assafœtida

* See Lewis's Mat. Med.

† Dr. Cullen prefers it to the Gum Ammon as an expectorant. Assafœtida should therefore have a double advantage in spasmodic asthmas.

plant in Britain, if not in Europe, from seeds sent to his friend Dr. Guthrie of St. Petersburg, from the mountains of Ghiam, in Persia: but the plant at present regarded as genuine is a different species, a native of the north; the former is now denominated Ferula Persica.

[*Amœnitates. Exoticæ. Wildenow. Woodville.*

SECTION XXIX.

Opium Plant.

Papaver Somniferum.—WILDEN.

THE poppy genus contains nine species, of which two are employed in medicine. 1. P. rhæas, or wild globular-headed poppy, common to our corn-fields, and flowering in June and July, the flowers of which are said to be slightly anodyne, but which are chiefly made use of on account of their elegant red hue, being for the sake of the hue boiled and preserved as a syrup; and 2. P. somniferum, the article immediately before us. The root of this is annual, tapering, and branched; the stalk is round, smooth, erect, often branched, of a glaucous green colour, and rises two or three feet in height; the leaves are alternate, large, ovate, lobed, smooth, deeply cut into various segments, and closely embrace the stalk; the flowers are very large, terminal, and usually white or purplish; the calyx consists of two leaves, which are ovate, smooth, concave, bifid, and fall off on the opening of the flower: the corolla consists of four petals, which are large, roundish, entire, undulated; the filaments are numerous, slender, much shorter than the corol, and furnished with oblong erect compressed anthers; the germ is large, globular, and upon it is placed the stigma, which is large, flat, radiated, and forms a kind of crown; the capsule is one-celled, smooth, divided half way into many cells, which open by several apertures beneath the crown, and contain very numerous small white seeds. It is a native of England, usually growing in neglected gardens, or uncultivated rich grounds, and flowers in July and August.

This species is said to have been named white poppy from the whiteness of its seeds; a variety of it, however, is well known to produce black seeds: the double-flowered white poppy is also

another variety; but for medicinal purposes any of these may be employed indiscriminately, as we are not able to discover the least difference in their sensible qualities or effects.

The seeds, according to some authors, possess a narcotic power; but there is no foundation for this opinion; they consist of a simple farinaceous matter, united with a bland oil, and in many countries are eaten as food. As a medicine, they have been usually given in the form of emulsion, in catarrhs, stranguaries, &c.

The heads or capsules of the poppy, which are directed for use in the Pharmacopœias, like the stalks and leaves have an unpleasant smell, somewhat like that of opium, and an acrid bitterish taste. Both the smell and taste reside in a milky juice, which more especially abounds in the cortical part of the capsules, and in its concrete state constitutes the officinal opium. These capsules are powerfully narcotic, or anodyne; boiled in water, they impart to the menstruum their narcotic juice, together with the other juices which they have in common with vegetable matters in general. The liquor, strongly pressed out, suffered to settle, clarified with whites of eggs, and evaporated to a due consistence, yields an extract which is about one-fifth or one-sixth of the weight of the heads. This possesses the virtues of opium, but requires to be given in double its dose to answer the same intention, which it is said to perform without occasioning a nausea and giddiness, the usual effects of opium. This extract was first recommended by Mr. Arnot; and a similar one is now received in the Edinburgh Pharmacopœia. It is found very convenient to prepare the syrup from this extract, by dissolving one dram in two pounds and a half of simple syrup. The syrupus papaveris albi, as directed by both colleges, is a useful anodyne, and often succeeds in procuring sleep, where opium fails; it is more especially adapted to children. White poppy heads are also used externally in fomentations, either alone, or more frequently added to the decoctum pro fomento.

Opium, as we have already observed, is obtained from the heads or capsules of this species of poppy, and is imported into Europe from Persia, Arabia, and other warm regions of Asia. The manner in which it is collected has been described long ago by Kæmpfer and others; but the most circumstantial detail of the culture of the poppy, and the method of procuring the opium from it, is that

given by Mr. Kerr, as practised in the province of Baha: he says, "The field being well prepared by the plough and harrow, and reduced to an exact level superficies, it is then divided into quadrangular areas of seven feet long, and five feet in breadth, leaving two feet of interval, which is raised five or six inches, and excavated into an aqueduct for conveying water to every area, for which purpose they have a well in every cultivated field. The seeds are sown in October or November. The plants are allowed to grow six or eight inches distant from each other, and are plentifully supplied with water. When the young plants are six or eight inches high, they are watered more sparingly. But the cultivator strews all over the areas a nutrient compost of ashes, human excrements, cow-dung, and a large portion of nitrous earth, scraped from the highways and old mud walls. When the plants are nigh flowering, they are watered profusely to increase the juice.

"When the capsules are half grown, no more water is given, and they begin to collect the opium.

"At sun-set they make two longitudinal double incisions upon each half-ripe capsule, passing from below upwards, and taking care not to penetrate the internal cavity of the capsule. The incisions are repeated every evening until each capsule has received six or eight wounds; they are then allowed to ripen their seeds. The ripe capsules afford little or no juice. If the wound was made in the heat of the day, a cicatrix would be too soon formed. The night dews by their moisture favour the exstillation of the juice.

"Early in the morning, old women, boys, and girls, collect the juice by scraping it off the wounds with a small iron scoop, and deposit the whole in an earthen-pot, where it is worked by the hand in the open sunshine, until it becomes of a considerable spissitude. It is then formed into cakes of a globular shape, and about four pounds in weight, and laid into little earthen basins to be further exsiccated. These cakes are covered over with the poppy or tobacco leaves, and dried until they are fit for sale. Opium is frequently adulterated with cow-dung, the extract of the poppy plant procured by boiling, and various other substances which they keep in secresy."——"Opium is here a considerable branch of commerce. There are about 600,000 pounds of it annually exported from the Ganges."

It appears to us highly probable, that the white poppy might be cultivated for the purpose of obtaining opium to great advantage in Britain. Alston says, "the milky juice, drawn by incision from poppy-heads, and thickened either in the sun or shade, even in this country, has all the characters of good opium; its colour, consistence, taste, smell, faculties, phænomena, are all the same; only, if carefully collected, it is more pure and more free of feculencies."

Similar remarks have also been made by others, to which we may add those of our own; for during a late summer, we at different times made incisions in the green capsules of the white poppy, from which we collected the juice, which soon acquired a due consistence, and was found, both by its sensible qualities and effects, to be very pure opium.

Opium, called also Opium Thebaicum, from being anciently prepared chiefly at Thebes, has been a celebrated medicine from the remotest times. It differs from the Meconium, which by the ancients was made of the expressed juice or decoction of the poppies.

Opium is imported into Europe in flat cakes, covered with leaves to prevent their sticking together: it has a reddish brown colour, and a strong peculiar smell; its taste at first is nauseous and bitter, but soon becomes acrid, and produces a slight warmth in the mouth; a watery tincture of it forms an ink, with a chalybeate solution. According to the experiments of Alston, it appears to consist of about five parts in twelve of gummy matter, four of resinous matter, and three of earthy, or other indissoluble impurities.

The use of this celebrated medicine, though not known to Hippocrates, can be clearly traced back to Diagoras, who was nearly his cotemporary, and its importance has ever since been gradually advanced by succeeding physicians of different nations. Its extensive practical utility, however, has not been long well understood; and in this country, perhaps, may be dated from the time of Sydenham. Opium is the chief narcotic now employed; it acts directly upon the nervous power, diminishing the sensibility, irritability, and mobility of the system; and, according to a late ingenious author, in a certain manner suspending the motion of the nervous fluid, to and from the brain, and thereby inducing sleep, one of its principal effects. From this sedative power of opium, by which it allays pain, inordinate action, and restlessness, it naturally follows, that it may be employed with advantage in a great variety of diseases.

Indeed, there is scarcely any disorder in which, under some circumstances, its use is not found proper; and though in many cases it fails of producing sleep, yet if taken in a full dose, it occasions a pleasant tranquillity of mind, and a drowsiness, which approaches to sleep, and which always refreshes the patient. Besides the sedative power of opium, it is known to act more or less as a stimulant, exciting the motion of the blood; but this increased action has been ingeniously, and, as we think, rationally ascribed to that general law of the animal œconomy, by which any noxious influence is resisted by a consequent re-action of the system. By a certain conjoined effort of this sedative and stimulant effect, opium has been thought to produce intoxication, a quality for which it is much used in eastern countries.

The requisite dose of opium varies in different persons, and in different states of the same person. A quarter of a grain will in one adult produce effects which ten times the quantity will not do in another; and a dose that might prove fatal in cholera or cholic, would not be perceptible in many cases of tetanus or mania. The lowest fatal dose, to those unaccustomed to take it, seems to be about four grains; but a dangerous dose is so apt to produce vomiting, that it has seldom time to occasion death. When given in too small a dose, it often produces disturbed sleep, and other disagreeable consequences; and in some cases it seems impossible to be made to agree in any dose or form. Often, on the other hand, from a small dose, sound sleep and alleviation of pain will be produced, while a larger one occasions vertigo and delirium. Some prefer the repetition of small doses; others the giving a full dose at once: its operation is supposed to last about eight hours.

Among the Turks opium is much in use. Wine is indeed strictly prohibited by their religion. Mahomet knew his disciples too well to entrust them with the use of it; for they are strangers to moderation in their passions: wine seems to have a different effect on their constitution from what it has on the rest of mankind; it drives them generally to fury, frenzy, and distraction. But, notwithstanding the prohibition, the vice of drinking gains ground with the Turks, and imperceptibly creeps from the lower to the higher stations; perhaps in this instance, as in many others, restraint may quicken appetite and inflame desire. Men of some distinction, even

those in great offices, frequently make what they call parties of pleasure, merely to get dead drunk; and after lying two or three days wallowing in their liquor, return fresh and happy to their office. A frequent request to such Christians as they know they can trust is, to procure them the best wine. Some principal officers, both in the seraglio and Porte, have so strong a passion for it, that they have invented small leathern boxes, in which they convey it home without the privity of their trustiest servants: others fill large leathern pipes, which are pliant, round their bodies, and so carry wine clandestinely into the seraglio, at the risk perhaps of their lives. When it happens that, toward the decline of life, religious scruples have seized them, or that those in high offices have apprehended the Grand Seignior might discover them by the odour of their morning draught, they frequently change their wine to opium, which is equally intoxicating, and perhaps attended with worse consequences, both to the corporeal and mental faculties. Some still continue that practice; but at present those among the great, who feel scruples or fear the discovery, rather betake themselves to distilled strong waters, with which they are abundantly supplied from Zante and Corfu. The casuistry with which they silence their scruples is, that fire, which purifies all things, has, in distillation, destroyed and dissipated the impure parts of the wine; and that brandy is no where expressly interdicted by Mahomet. The vice of drinking wine is, however, looked upon with detestation by the generality of Turks; and even the use of opium is held in great contempt, as a vicious practice. When they would depreciate the character of any considerable man who is known to chew it, they call him a *Tiriachi*, that is, "an opium-eater," by which they mean a person of an extravagant and irregular turn of mind.

[*Junker. Wildenow. Woodville. Amœnitates Academicæ.*

CHAP. VI.

VEGETABLE POISONS.

SECTION I.

Preliminary Observations.

A POISON may be defined to be any substance which, when applied to the animal frame externally or internally, injures or destroys it, by exciting morbid action. This definition, we allow, is extensive; but the diversified nature of the substances that fall within the meaning of the term, and the multiform mode of their action, prevent us from being able to limit it within narrower bounds. Poisons may, therefore, be contemplated under the four classes of animal, vegetable, mineral, and hallituous. At the two last we have already occasionally glanced, in various chapters of the first book of the present work; the more curious of the animal poisons will fall within the scope of the ensuing book; and we have only, in the division before us, to notice those that belong to the vegetable world.

Preliminarily, however, we will observe, that most of the substances properly called poisonous, are only so in certain doses; for below this point in the general scale, many of them form the most active and consequently the most valuable medicines of the dispensatory. There are nevertheless some poisons which are deleterious and even fatal in the smallest quantities imaginable, and which are hence never administered medicinally; such are those of hydrophobia and the plague. There are other poisons, again, which are innocent when taken into the stomach, but which prove deleterious when applied to the lungs, or to an abraded surface; thus carbonic acid is continually swallowed with fermented liquors with impunity, and the poison of the viper may be taken in the same manner: whilst inspiring carbonic acid kills, and the poison of the viper inserted into the flesh often proves fatal.

There is again a third kind of substances which act as poisons whether applied externally or internally, as arsenic.

When a substance produces disease not only in mankind but in all animals, it is distinguished by the term common poison, as arsenic, sublimate, &c. whilst that which is poisonous to man only, or to animals, and often to one genus, is said to be a relative poison; thus aloes is poisonous to dogs and wolves; the phellandrium aquaticum kills horses, whilst oxen devour it greedily and with impunity. It appears, then, that substances act as poisons only in regard to their dose, the part of the body they are applied to, and the subject.

Narcotic Poisonous Vegetables.

1. Papaver somniferum *

Vomits, acids, and the other anti-narcotics mentioned at the end of this table, are the antidotes.

2. Opium

This requires the same antidotes.

3. Physalis somnifera
4. Solanum lycopersicum
5. Solanum mammosum
6. Solanum insanum
7. Solanum dulcamara
8. Solanum nigrum
9. Altropa mandragora
10. Datura stramonium
11. Datura metel
12. Datura ferox
13. Datura tatula
14. Hyosciamus niger

The antidotes are first vomits, which also purge, then vinegar and oil.

15. Hyosciamus albus
16. Hyosciamus physalodes
17. Hyosciamus scopolia
18. Azalea pontica
19. Antirrhinum orontium
20. Actæa spicata
21. Lolium temulentum
22. Ervum ervilia
23. Lathyrus cicera
24. Peganum harmela.
25. Chenopodium hybridum
26. Cheledonium glaucium
27. Taxus baccata
28. Lactuca virosa
29. Lactuca scariola
30. Paris quadrifolia
31. Prunus lauro cerasus.

Against all these narcotics are recommended, after vomiting.

1. Acids; as vinegar, lemon-juice, spirits of vitriol diluted. 2. A very strong infusion of Turkey coffee. 3. Small doses

* It is difficult, as we have already observed, to draw the line between medicines and poisons; this and many in the ensuing list are both.

of ipecacuan, to promote a powerful sweating. 4. Glysters of vinegar, or soap dissolved. 5. Blisters to the neck. 6. Wine. 7. Alkaline salts and borax.

Narcotic and Acrid Vegetable Poisons.

1. Hippomane mancinella*
An emetic and purge, then milk and rice-broth.
2. Hippomane biglandulosa
3. Cocculus indicus
4. Coriaria myrtifolia
5. Strychnos nux vomica
6. Strychnos colubrina
7. Ignatia amara
8. Nerium oleander
9. Atropa belladonna
10. Nicotiana tabacum
11. Nicotiana rustica
12. Nicotiana paniculata
13. Nicotiana glutinosa
14. Bryonia alba
15. Chærophyllum sylvestre
16. Chærophyllum bulbosum
17. Chærophyllum temulentem
18. Œthusa cynapium
19. Sium latifolium
20. Cicuta virosa
21. Conium maculatum
22. Mercurialis perennis.

Poisonous Funguses.

1. Agaricus muscarius
2. Agaricus integer venenatus, Krapfii
3. Agaricus integer viscidus, Krapfii
4. Agaricus lactifluus venenatus, Krapfii
5. Agaricus piperatus
6. Agaricus fimetarius
7. Agaricus pustulatus
8. Agaricus necator
9. Agaricus sanguineus
10. Agaricus viscidus
11. Agaricus clypeatus
12. Boletus versicolor
13. Boletus elegans
14. Boleti parasitica
15. Phallus impudicus
16. Phallus mukusin
17. Lycoperdon carcinomalis
18. And several others not scientifically named.

Acid Vegetable Poisons.

1. Delphinia staphisagria
2. Veratrum sabadillæ
3. Rhododendron crysanthium
4. Fritillaria imperialis
5. Colchicum autumnale
6. Pedicularis palustris
7. Digitalis purpurea
8. Cyclamen europæum
9. Plumbago europæa
10. Convolvulus scammonium
11. Cucumis colocynthis
12. Momordica elaterium

13. Gambogia gutta
14. Cerbera abhovai
15. Cerbera manghas
16. Cynanchum erectum
17. Lobelia syphilitica
18. Lobelia longifolia
19. Cynanchum viminale
20. Apocymum androsemifolium
21. Apocinum cannubinum
22. Apocynum venetum
23. Asclepias gigantea
24. Hydrocotale vulgaris
25. Œnanthe fistulosa
26. Œnanthe crocata
27. Scandix infesta
28. Thapsia fœtida
29. Alisma plantago aquatica
30. Clematis vitalba
31. Clematis flammula
32. Clematis recta
33. Clematis integrifolia
34. Anemone palmata
35. Anemone pulsatilla
36. Anemone pratensis
37. Anemone narcissistora
38. Anemone nemerosa
39. Anemone ranunculoides
40. Veratrum album
41. Helleborus niger
42. Helleborus fœtida
43. Veratrum nigrum
44. Caltha palustris
45. Aconitum napellus
46. Aconitum cammarum
47. Aconitum lycoctonum
48. Aconitum athora
49. Pastinæa sativa annosia
50. Poligonum hydropiper
51. Sælanthus quadragonus
52. Sælanthus forskalli
53. Sælanthus glandulosus
54. Jatropha curcas
55. Jatropha multifida
56. Jatropha manihot
57. Ricinus communis
58. Phytolacca decandra
59. Croton tiglium
60. Daphne mezereum
61. Daphne thymelæa
62. Daphne laureola
63. Daphne cneorum
64. Daphne gnidium
65. Cneorum tricoccum
66. Amyris toxifera
67. Rhus vernix
68. Rhus radicans
69. Rhus toxicodendron
70. Scilla maritima
71. Excoecaria agallocha
72. Anacardium orientale
73. Anacardium occidentale
74. Caryota urens
75. Arum maculatum
76. Arum dracunculus
77. Arum dracontium
78. Arum colocasia
79. Arum esculentum
80. Arum virginicum
81. Arum arborescens
82. Arum seguinum
83. Calla palustris
84. Euphorbia officinarum
85. Euphorbia antiquorum
86. Euphorbia canariensis
87. Euphorbia tirucalli
88. Euphorbia peplus
89. Euphorbia lathyris
90. Euphorbia helioscopia

91. Euphorbia verrucosa
92. Euphorbia platyphyllos
93. Euphorbia esula
94. Euphorbia cyparissias
95. Euphorbia hiberna
96. Euphorbia characias
97. Euphorbia amygdaloides
98. Euphorbia sylvatica
99. Euphorbia exigua acuta
100. Euphorbia mauritanica
101. Euphorbia nerifolia
102. Ranunculus acris
103. Ranunculus sceleratus
104. Ranunculus flamula
105. Ranunculus bulbosus
106. Ranunculus ficaria
107. Ranunculus thora
108. Ranunculus arvensis
109. Ranunculus lingua
110. Ranunculus alpestres
111. Ranunculus polyanthemos
112. Ranunculus illyricus
113. Ranunculus gramineus
114. Ranunculus asiaticus
115. Ranunculus aquatilus
116. Ranunculus platanifolius
117. Ranunculus breynius
118. Ranunculus sardous
119. Rhaphanus raphanistrum
120. Secale cornutum. Its antidote is milk.

The usual and most approved antidotes to all these are, after vomiting and purging, emollient substances; as panada with butter, and wine and cordials to support the strength.

Glutinous Vegetable Poisons.

1. Ilex aquifolium
2. Viscum album
3. Rosa canina.

Poisonous substances produce very different effects, according to the manner they are introduced into the system, and the organ with which they primarily come into contact. This is a very curious subject of enquiry, and one which has, within the last year or two, been pursued so successfully, and with such singular results by Mr. Brodie, that we shall make no apology to our readers for copying the following extract from his paper upon the subject, introduced into the Philosophical Transactions for 1811.

The substances, observes Mr. Brodie, which act as poisons when applied to the animal body, are very numerous. In the experiments which I have hitherto made, I have employed vegetable poisons only. Of these I have selected such as are very active and certain in producing their effects, believing that, on this account, the exact nature of those effects would be more readily ascertained. The principal objects which I have kept in view have been to determine

on which of the vital organs the poison employed exercises its primary influence, and through what medium that organ becomes affected. I have also endeavoured to ascertain by what means the fatal consequences of some poisons may be prevented. With some of the conclusions which I have ventured to draw, so far as I know, we were not before acquainted; and others of them, though not entirely new, had not been previously established by satisfactory experiments.

I shall relate first those experiments in which poisons were employed internally, that is, to the mucous membranes of the tongue or alimentary canal, and afterwards those in which poisons were applied to wounded surfaces.

1. *Experiments with Poisons applied to the Tongue or Alimentary Canal.*

Alcohol.

When spirits are taken into the stomach in a certain quantity, they produce that kind of delirium which constitutes intoxication: when taken in a larger quantity, it is well known that they destroy life altogether, and that in the course of a very short space of time. Intoxication is a derangement of the functions of the mind, and, as these are in some way connected with those of the brain, it seems probable, that it is by acting on this organ that spirits when taken into the stomach occasion death. In order to ascertain how far this conclusion is just, I made the following experiments.

Exp. 1.—I poured two drachms of proof spirits down the œsophagus of a cat. Instantly he struggled violently; then lay on one side, perfectly motionless and insensible; the breathing was laboured and stertorous, and the pulsations of the heart were very frequent. He continued in this state for seven or eight minutes; then began to recover; the respirations became easier, and presently he stood up, and was able to walk.

Exp. 2.—I injected an ounce and a half of proof spirits into the stomach of a large full-grown rabbit, by means of an elastic gum tube passed down the œsophagus. The same symptoms took place as in the last experiment; but the animal did not begin to recover

from the state of insensibility until forty minutes had elapsed from the time of the injection.

Exp. 3.—Seven drachms of proof spirits were injected into the stomach of a young rabbit. Two minutes afterwards, he was evidently affected by the spirits, and in three minutes more he lay on one side motionless and insensible. The pupils of the eyes were perfectly dilated; there were occasional slight convulsive motions of the extremities; the respiration was laborious, it was gradually performed at longer and longer intervals, and at the end of an hour and fifteen minutes had entirely ceased. Two minutes after the animal was apparently dead, I opened into the thorax, and found the heart acting with moderate force and frequency, circulating dark-coloured blood. I introduced a tube into the trachea, and produced artificial respiration by inflating the lungs, and found that by these means the action of the heart might be kept up to the natural standard, as in an animal from whom the head is removed.

Exp. 4.—I injected into the stomach of a rabbit two ounces of proof spirits. The injection was scarcely completed, when the animal became perfectly insensible. Precisely the same symptoms took place as in the last experiment, and at the end of twenty-seven minutes, from the time of the injection, the rabbit was apparently dead; but on examining the thorax the heart was found still acting, as in the last experiment.

It has been shown by M. Bichat, and the observation has been confirmed by some experiments which I have lately had the honour of communicating, that the brain is not directly necessary to the action of the heart, and that when the functions of the brain are destroyed, the heart continues to contract for some time afterwards, and then ceases only in consequence of the suspension of respiration, which is under the influence of the brain.

It would appear, from the experiments which I have just detailed, that the symptoms produced by a large quantity of spirits taken into the stomach arise entirely from disturbance of the functions of the brain. The complete insensibility to external impressions; the dilatation of the pupils of the eyes; and the loss of motion, indicate that the functions of this organ are suspended; respiration, which is under its influence, is ill performed, and at last altogether

ceases; while the heart, to the action of which the brain is not directly necessary, continues to contract, circulating dark-coloured blood for some time afterwards.

There is a striking analogy between the symptoms arising from spirits taken internally, and those produced by injuries of the brain.

Concussion of the brain, which may be considered as the slightest degree of injury, occasions a state of mind resembling intoxication, and the resemblance in some instances is so complete, that the most accurate observer cannot form a diagnosis, except from the history of the case. Pressure on the brain, which is a more severe injury than concussion, produces loss of motion, insensibility, dilatation of the pupils; respiration becomes laboured and stertorous, is performed at long intervals, and at last altogether ceases, and the patient dies.

It forms an interesting matter of enquiry, whether spirits when taken into the stomach produce their effects on the brain by being absorbed into the circulation, or in consequence of the sympathy that exists between these organs by means of the nerves. The following circumstances lead me to conclude that they act in the last of these two ways.

1. In experiments where animals have been killed by the injection of spirits into the stomach, I have found this organ to bear the marks of great inflammation, but never found any preternatural appearances whatever in the brain. 2. The effects of spirits taken into the stomach in the last experiment were so instantaneous, that it appears impossible that absorption should have taken place before they were produced. 3. A person who is intoxicated, frequently becomes suddenly sober after vomiting. 4. In the experiments which I have just related, I mixed tincture of rhubarb with the spirits, knowing from the experiments of Mr. Home, and Mr. William Brande, that this, when absorbed into the circulation, was readily separated from the blood by the kidneys, and that very small quantities might be detected in the urine by the addition of potash; but, though I never failed to find urine in the bladder, I never detected rhubarb in it.

The including the termination of the thoracic duct in a ligature does not prevent spirits, when taken into the stomach, from producing their usual effects on the nervous system; but subsequent

observations, which Mr. Home has already communicated, have shown that no conclusion can be drawn from this experiment.

That a poison may affect a distant organ, through the medium of the nerves, without entering the circulation, is proved by the well known circumstance of solution of the extract of belladonna, when applied to the tunica conjunctiva of the eye, occasioning dilatation of the pupil of the same eye, though no other part of the system is affected.

It has been formerly supposed by Dr. Mead and other physiologists, that a poison may produce death by acting on the extremities of the nerves of the stomach and intestines, without being absorbed into the circulation. That it should by these means be capable of affecting the brain is not to be wondered at, when we consider the numerous and various sympathies between this organ and the alimentary canal, evidently independent of any other communication than the nerves.

Essential oil of bitter almonds.

Exp. 5.—One drop of the essential oil of bitter almonds was applied to the tongue of a young cat. She was instantly ceased with violent convulsions, then lay on one side motionless, insensible; breathing in a hurried manner; the respirations became laboured, took place at longer and longer intervals, and at the end of five minutes, from the application of the poison, had entirely ceased, and the animal was apparently dead; but on opening the thorax, the heart was found acting regularly eighty times in a minute, circulating dark-coloured blood, and it continued to act for six or seven minutes afterwards.

Exp. 6.—I injected into the rectum of a cat half an ounce of water, with two drops of the essential oil. In two minutes afterwards, he was affected with symptoms similar to those which occurred in the last experiment, and at the end of five minutes, from the injection of the poison, he was apparently dead. Two minutes after apparent death, the heart was found acting eighty times in a minute. On dissection, no preternatural appearances were found either in the internal membrane of the rectum, or the brain.

The symptoms produced by this poison, and the circumstance of the heart continuing to contract after apparent death, lead to

the conclusion that it occasions death by disturbing the functions of the brain.

While engaged in these last experiments, I dipped the blunt end of a probe into the essential oil, and applied it to my tongue, meaning to taste it, and having no suspicion that so small a quantity could produce any of its specific effects on the nervous system; but scarcely had I applied it, when I experienced a very remarkable and unpleasant sensation, which I referred chiefly to the epigastric region, but the exact nature of which I cannot describe, because I know nothing precisely similar to it. At the same time there was a sense of weakness in my limbs, as if I had not the command of my muscles, and I thought that I was about to fall. However, these sensations were momentary, and I experienced no inconvenience whatever afterwards.

I afterwards applied a more minute quantity of the essential oil to my tongue several times, without experiencing from it any disagreeable effects; but on applying a larger quantity, I was affected with the same momentary sensations as in the former instance, and there was a recurrence of them in three or four seconds after the first attack had subsided.

From the instantaneousness with which the effects are produced; and from its acting more speedily when applied to the tongue than when injected into the intestine, though the latter presents a better absorbing surface, we may conclude that this poison acts on the brain through the medium of the nerves, without being absorbed into the circulation.

Juice of the leaves of aconite.

Exp. 7.—An ounce of this juice was injected into the rectum of a cat. Three minutes afterwards he voided what appeared to be nearly the whole of the injection; he then stood for some minutes perfectly motionless, with his legs drawn together; at the end of nine minutes, from the time of the injection, he retched and vomited; he then attempted to walk, but faltered and fell at every step, as if from giddiness. At the end of thirteen minutes, he lay on one side insensible, motionless, except some slight convulsive motions of the limbs. The respiration became slow and laboured; and at forty-seven minutes from the time of the injection, he was

apparently dead. One minute and a half afterwards, the heart was found contracting regularly one hundred times in a minute.

It appears from this experiment, that the juice of aconite, when injected into the intestine, occasions death by destroying the functions of the brain. From the analogy of other poisons, it is rendered probable that it acts on the brain through the medium of the nerves, without being absorbed into the circulation. This opinion is confirmed by the following circumstance: if a small quantity of the leaf of aconite is chewed, it occasions a remarkable sense of numbness of the lips and gums, which does not subside for two or three hours.

Infusion of Tobacco.

Exp. 8.—Four ounces of infusion of tobacco were injected into the rectum of a dog. Four minutes afterwards he retched, but did not vomit; he then became faint, and lay motionless on one side; at the end of nine minutes from the time of the injection, the heart could not be felt; he gasped for breath at long intervals; and in another minute there was no appearance whatever of life. I immediately laid open the cavities of the thorax and abdomen. The heart was much distended, and had entirely ceased to contract; there was no peristaltic motion of the intestines.

Exp. 9.—An ounce of very strong infusion of tobacco was injected into the rectum of a cat. Symptoms were produced similar to those which occurred in the last experiment, and the animal died at the end of seven minutes from the time of the injection. On opening the thorax immediately after death, the heart was found extremely distended, and to have entirely ceased acting, with the exception of a slight tremulous motion of the auricles.

Exp. 10.—Three ounces of infusion of tobacco were injected into the rectum of a dog. He was affected with symptoms similar to those in the former experiments, and died at the end of ten minutes. On opening the thorax immediately after death, I found the heart much distended, and to have entirely ceased contracting.

Exp. 11.—Three ounces of infusion of tobacco were injected into the rectum of a dog. Immediately there took place tremulous contractions of the voluntary muscles. Five minutes after-

wards the injection was repeated in the same quantity. The dog then was sick, and threw up some of the infusion, with other matter, from the stomach; he became faint, and died ten minutes after the second injection. Immediately after respiration had ceased, I opened the thorax, and found the heart extremely extended, and without any evident contraction, except of the appendix of the right auricle, which every now and then contracted in a slight degree. I divided the pericardium on the right side. In consequence of the extreme distension of the heart, this could not be done without irritating the fibres with the point of the scalpel. Immediately both auricles and ventricles began to contract with considerable force, so as to restore the circulation. Artificial respiration was produced, and the circulation was kept up for more than half an hour, beyond which time the experiment was not continued.

We may conclude from these experiments, that the effect of the infusion of tobacco, when injected into the intestine of a living animal, is to destroy the action of the heart, stopping the circulation and producing syncope. It appeared to me that the action of the heart ceased even before the animal had ceased to respire; and this was confirmed by another experiment, in which, in a dog killed by the infusion of tobacco, I found the cavities of the left side of the heart to contain scarlet blood, while in those of the right side the blood was dark-coloured. This poison therefore differs materially from alcohol, the essential oil of almonds, and the juice of aconite, which have no direct influence on the action of the heart. The infusion of tobacco renders the heart insensible to the stimulus of the blood, but it does not altogether destroy the power of muscular contraction, since the heart resumed its action in one instance on the division of the pericardium, and I have found that the voluntary muscles of an animal killed by this poison are as readily stimulated to contract by the influence of the Voltaic battery, as if it had been killed in any other manner. At the same time, however, that the infusion of tobacco destroys the action of the heart, it appears to destroy also the functions of the brain, since these did not return in the last experiment; although the circulation was restored, and kept up by artificial respiration.

Since there is no direct communication between the intestinal canal and the heart, I was at first induced to suppose that the lat-

ter becomes affected in consequence of the infusion being conveyed into the blood by absorption. Some circumstances in the following experiment have since led me to doubt whether this is the case.

Exp. 12.—In a dog, whose head was removed, I kept up the circulation by means of artificial respiration, in the manner already described in the account of some experiments which I lately communicated. I then injected into the stomach and intestines nine ounces of infusion of tobacco. At the time of the injection, the body of the animal lay perfectly quiet and motionless on the table; the heart acted regularly one hundred times in a minute. Ten minutes afterwards the pulse rose to one hundred and forty in a minute; the peristaltic motion of the intestines was much increased, and the voluntary muscles in every part of the body were thrown into repeated and violent spasmodic action. The joints of the extremities were alternately bent and extended; the muscles of the spine, abdomen, and tail alternately relaxed and contracted, so as to turn the whole animal from one side to the other. I have observed, in other instances, spasmodic actions of the muscles, where the circulation was kept up by artificial respiration, after the removal of the head, but not at all to be compared, either in strength or frequency, with those which took place on this occasion. I made pressure on the abdominal aorta for more than a minute, so as to obstruct the circulation of the blood in the lower extremities; but the muscular contractions were not lessened in consequence. Half an hour after the injection of the infusion, the artificial respiration was discontinued. The heart continued to act, circulating dark-coloured blood; the muscular contractions continued, but gradually diminished, in strength and frequency. I tied a ligature round the vessels at the base of the heart, so as to stop the circulation; nevertheless the muscular contractions still continued, though less frequent and forcible than before, and some minutes elapsed before they entirely ceased.

In this experiment, the disposition to contraction in the muscles was very much increased, instead of being diminished, as in those just related. If the infusion of tobacco influences the heart from being absorbed into the blood, and thus coming into actual contact with its fibres, there is no evident reason why the removal of the brain, and the employment of artificial respiration, should occasion

so material a difference in its effects. If the contractions of the voluntary muscles had depended on the infusion circulating with the blood, it is reasonable to suppose that the pressure on the aorta would have occasioned some diminution of them, and that the complete obstruction of the circulation would have caused them to cease altogether.

From these considerations, I am induced, on the whole, to believe that the infusion of tobacco, when injected into the intestines, influences the heart through the medium of the nervous system; but I have not been able to devise any experiment, by which the truth or fallacy of this opinion might be put beyond the reach of doubt.

It appears remarkable, that the brain and nervous system, although not necessary to the action of the heart, should, when under the influence of the infusion of tobacco, be capable of influencing this organ so as to stop its action; but this is analogous to what we see occur in consequence of violent emotions of the mind. Those states of the nervous system which accompany the passions of joy, fear, or anger, when existing in a moderate degree, render the heart more sensible to the stimulus of the blood, and increase the frequency of its contractions; while, when the same passions exist in a greater degree, the heart is rendered altogether insensible to the stimulus of the blood, and syncope ensues.

Empyreumatic oil of Tobacco.

Exp. 13.—Less than a drop of this oil was applied to the tongue of a young cat. Instantly violent convulsions took place in all the muscles, and the respirations became very frequent. In five minutes after the application, she lay on one side insensible, with slight spasmodic actions of the muscles. At the end of eleven minutes she retched, but did not vomit. In a quarter of an hour she appeared to be recovering. I repeated the application of the poison, and she was again seized with violent convulsions, and became insensible, breathing at long intervals; and in two minutes from the second application respiration had entirely ceased, and she was apparently dead. On opening the thorax, I found the heart acting with regularity and strength, circulating dark-coloured blood. I introduced a tube into the trachea, and produced artificial respiration; the contractions of the heart became augmented in force and

frequency, and there was no evident diminution in six or seven minutes, during which the artificial respiration was continued.

On dissection, nothing remarkable was found in the appearance of the tongue or brain.

The symptoms and mode of death, in this experiment, did not essentially differ from those produced by the essential oil of almonds. I was surprised to find the effects of the empyreumatic oil so entirely different from those of the infusion of tobacco. Supposing that this difference might arise from the poison being more concentrated in the oil than in the infusion, I made the following experiments.

Exp. 14.—A drop of the oil of tobacco was suspended in an ounce and a half of water by means of mucilage of gum arabic, and the whole was injected into the rectum of a dog. In two minutes afterwards he became faint, retched, but did not vomit. He appeared to be recovering from this state, and in twenty-five minutes after the first injection it was repeated in the same quantity. He was then seized with symptoms similar to those in the last experiment, and in two minutes and a half he was apparently dead.

Two minutes after apparent death, on the thorax being opened into, the heart was found acting regularly one hundred times in a minute, and it continued acting for several minutes.

Exp. 15.—A drop of the empyreumatic oil of tobacco with an ounce of water was injected into the rectum of a cat. The symptoms produced were in essential circumstances similar to those which occurred in the last experiment. The animal was apparently dead five minutes after the injection, and the heart continued to contract for several minutes afterwards.

We may conclude from these experiments, that the empyreumatic oil of tobacco, whether applied to the tongue or injected into the intestine, does not stop the action of the heart and induce syncope, like the infusion of tobacco; but that it occasions death by destroying the functions of the brain, without directly acting on the circulation. In other words, its effects are similar to those of alcohol, the juice of aconite, and the essential oil of almonds.

2. *Experiments with Poisons applied to wounded surfaces.*

Essential oil of almonds.

Exp. 16.—I made an incision in the thigh of a rabbit, and introduced two drops of essential oil between the skin and the muscles. In four minutes after the application, he was seized with violent convulsions, and became insensible, and in two minutes more he was apparently dead; but the heart was felt through the ribs acting one hundred and twenty times in a minute, and it continued acting for several minutes. There were no other appearances in the limb than would have resulted from an ordinary wound.

Exp. 17.—Two drops of the essential oil of almonds were introduced into a wound in the side of a mouse. Two minutes afterwards he was affected with symptoms similar to those which occurred in the last experiment, and in two minutes more he was apparently dead, but the heart continued to contract for some minutes afterwards.

From the experiments which I have just related, and from others which it appears unnecessary to detail, as the general results were the same, I have learned that where the essential oil of almonds is applied to a wound, its effects are not so instantaneous as when it is applied to the tongue; otherwise there is no difference in its effects, in whatever manner it is applied.

Juice of the leaves of aconite.

Exp. 18.—I made a wound in the side of a young rabbit, and introduced, between the skin and muscles, about twenty drops of the juice of aconite. Twenty-three minutes afterwards he was affected with symptoms in all essential respects similar to those which occurred in an experiment already related, where the juice was injected into the rectum, and at the end of forty-seven minutes from the application of the poison he was apparently dead. Two minutes after apparent death, the heart was found contracting, but very feebly.

Woorara.

The woorara is a poison with which the Indians of Guiana arm

the points of their arrows. It appears not to differ essentially from the ticunis, which was employed in the experiments of the Abbé Fontana.

Exp. 19.—A small quantity of the woorara in powder was applied to the wound in the side of a Guinea pig. Ten minutes afterwards the animal was unable to walk; then he became quite motionless, except some slight occasional convulsions. He gradually became insensible; the respirations were laboured, and at the end of fourteen minutes from the application of the poison the respiration had entirely ceased, and he was apparently dead; but on opening the thorax, the heart was found acting seventy times in a minute, circulating dark-coloured blood, and it continued to contract for several minutes afterwards. On dissection no preternatural appearances were observed in the brain, nor was there any other appearance in the limb than would have arisen from an ordinary wound.

Exp. 20.—I made a wound in the side of a Guinea pig, and introduced into it about two grains of the woorara in powder. At the end of twenty-five minutes, symptoms took place very similar to those which occurred in the last experiment, and in thirteen minutes more the animal was apparently dead; but the heart continued to contract one hundred and eight times in a minute, and by means of artificial respiration the circulation was kept up for more than twenty minutes.

The results of other experiments which I have made with the woorara were similar to those just described. The heart continued to act after apparent death, and the circulation might be kept up by means of artificial respiration. It is evident that this poison acts in some way or other on the brain, and that the cessation of the functions of this organ is the immediate cause of death.

I found in these experiments, that the best mode of applying the woorara is when it is dissolved in water to the consistence of a thin paste. I first made the wound, and then smeared the poison over it with the end of the scalpel. I found that the animal was more speedily and certainly affected if there was some hæmorrhage, unless the hæmorrhage was very copious, when it produced an opposite effect, by washing the poison away from the wound. When the poison was applied in large quantity, it sometimes began to act

in six or seven minutes. Never more than half an hour elapsed from the time of the poison being inserted to that of the animal being affected, except in one instance, where a ligature was applied on the limb. The woorara, which I employed, had been preserved for some years, which will account for its having been less active than it has been described to be by those who had witnessed its effects when in a recent state.

Upas antiar.

The island of Java produces two powerful vegetable poisons, to one of which the natives give the name of upas tieutè, and to the other that of upas antiar.

Exp. 21.—About two grains of this poison were made into a thin paste with water, and inserted into a wound in the thigh of a dog. Twelve minutes afterwards he became languid; at the end of fifteen minutes, the heart was found to beat very irregularly, and with frequent intermissions; after this, he had a slight rigor. At the end of twenty minutes, the heart beat very feebly and irregularly; he was languid; was sick and vomited; but the respirations were as frequent and as full as under natural circumstances, and he was perfectly sensible. At the end of twenty minutes he suddenly fell on one side, and was apparently dead. I immediately opened into the thorax, and found the heart distended with blood in a very remarkable degree, and to have entirely ceased contracting. There was one distinct and full inspiration after I had begun making the incision into the thorax. The cavities of the left side of the heart contained scarlet blood, and those of the right side contained dark-coloured blood, as in a living animal.

Exp. 22.—A small quantity of the upas antiar, prepared as before, was inserted into a wound in the thigh of a young cat. She appeared languid in two minutes after the poison was inserted. The symptoms which took place did not essentially differ from those which occurred in the last experiment, except that there were some convulsive motions of the limbs. At eight minutes after the poison was inserted, she lay on one side motionless and insensible, the heart could not be felt, but the respiration had not entirely ceased. On opening into the thorax, I found the heart to have ceased con-

tracting. It was much distended with blood: and the blood in the cavities of the left side was of a scarlet colour. There were two full inspirations after the incision of the thorax was begun. On irritating the heart with the point of the scalpel, slight contractions took place in the fibres of the appendices of the auricles, but none in any other part.

Exp. 23.—The experiment was repeated on a rabbit. The symptoms produced were similar to those in the last experiment; but the animal did not vomit, and the convulsive motions were in a less degree: he died eleven minutes after the poison was inserted. On opening the chest, the heart was found to have entirely ceased contracting; it was much distended with blood; and the blood in the cavities on the left side was of a scarlet colour. On irritating the heart with the point of the scalpel, the ventricles contracted, but not sufficiently to restore the circulation.

Exp. 24.—About a grain of the upas antiar was inserted into a wound in the side of a rabbit. He was affected with symptoms similar to those before described, and died in ten minutes after the poison was applied. On opening the thorax immediately after death, the heart was found to have ceased contracting, and the blood in the cavities of the left side was of a scarlet colour.

It appears from these experiments, that the upas antiar, when inserted into a wound, produces death (as infusion of tobacco does when injected into the intestines) by rendering the heart insensible to the stimulus of the blood, and stopping the circulation. The heart beats feebly and irregularly before either the functions of the mind or the respiration appear to be affected. Respiration is performed even after the circulation has ceased; and the left side of the heart is found after death to contain scarlet blood, which never can be the case where the cause of death is the cessation of the functions of the brain or lungs. The convulsions which occur when the circulation has nearly ceased, probably arise from the diminution of the supply of blood to the brain, resembling those which take place in a person who is dying from hæmorrhage.

There remains an interesting subject of enquiry, "through what medium do poisons influence the brain when applied to wounds? That poisons applied in this manner do not produce their effects precisely in the same way as poisons taken internally, is rendered

probable by this circumstance; that some poisons which are very powerful when applied to wounds even in small quantities, are either altogether inefficient when taken internally, or require to be given in very large quantities, in order to produce their effect, and *vice versâ.*

A poison applied to a wounded surface may be supposed to act on the brain in one of three ways.

1. By means of the nerves, like poisons taken internally.

2. By passing into the circulation through the absorbent vessels.

3. By passing directly into the circulation through the divided veins.

Exp. 25.—In order to ascertain whether the woorara acts through the medium of the nerves, I exposed the axilla of a rabbit, and divided the spinal nerves supplying the upper extremity, just before they unite to form the axillary plexus. The operation was performed with the greatest care. I not only divided every nervous filament, however small, which I could detect, but every portion of cellular membrane in the axilla, so that the artery and vein were left entirely insulated. I then made two wounds in the fore-arm, and inserted into them some of the woorara formed into a paste. Fourteen minutes after the poison was applied, the hind legs became paralytic, and in ten minutes more he died, with symptoms precisely similar to those which took place in the former experiments, and the heart continued to act after apparent death. On dissection, the nerves of the upper extremity were particularly examined, but not the smallest filament could be found undivided.

I made the following experiment, to ascertain whether the woorara passes into the circulation through the absorbent vessels.

Exp. 26.—I tied a ligature round the thoracic duct of a dog, just before it perforates the angle of the left subclavian and jugular veins. I then made two wounds in the left hind leg, and introduced some of the woorara in powder into them. In less than a quarter of an hour he became affected with the usual symptoms, and died in a few minutes afterwards.

After death, I dissected the thoracic duct with great care. I found it to have been perfectly secured by the ligature. It was very much distended with chyle; and about two inches below its termination its coats had given way, and chyle was extravasated into

the cellular membrane. The lymphatic vessels in the left axilla were distended in a very remarkable degree; and on dividing them, not less than a drachm of lymph issued from the divided ends.

Since neither the division of the nerves, nor the obstruction of the thoracic duct, interfere in the slightest degree with the effects of the woorara, there is presumptive evidence that it acts on the brain by entering the circulation through the divided veins. I endeavoured to ascertain, by experiment, whether this is really the case.

To apply ligatures to the large vessels of a limb only, would lead to no satisfactory conclusion, since the anatomosing vessels might still carry on the circulation. The only way which I could devise of performing the experiment was to include all the vessels, small as well as large, in a ligature.

Exp. 27.—In order to make the experiment more satisfactorily, I exposed the sciatic nerve of a rabbit in the upper and posterior part of the thigh, and passed under it a tape half an inch wide. I then made a wound in the leg, and having introduced into it some of the woorara mixed with water, I tied the tape moderately tight on the fore-part of the thigh. Thus I interrupted the communication between the wounds and the other parts of the body, by means of the vessels, while that by means of the nerves still remained. After the ligature was tightened, I applied the woorara a second time, in another part of the leg. The rabbit was not at all affected, and at the end of an hour I removed the ligature. Being engaged in some other pursuit, I did not watch the animal so closely as I should otherwise have done; but twenty minutes after the ligature was removed, I found him lying on one side, motionless and insensible, evidently under the influence of the poison; but the symptoms were less violent than in most instances, and after lying in this state he recovered, and the limb became perfectly warm, and he regained the power of using it.

Exp. 28.—I repeated the last experiment with this difference, that after having applied the poison, I made the ligature as tight as I could draw it. I removed the ligature at the end of an hour and twenty minutes, but the animal was not at all affected either before or after the removal of the ligature, and on the following day he had recovered the use of the limb.

Exp. 29.—I repeated the experiment a third time, drawing the ligature very tight. At the end of forty-five minutes the animal

continued perfectly well, and the ligature was removed. I watched him for three quarters of an hour afterwards, but there were no symptoms of his being affected by the poison. On the following day the rabbit died; but this I attribute to the injury done to the limb and sciatic nerve by the ligature, as there was the appearance of inflammation in the parts in the neighbourhood of the ligature.

These three experiments were made with the greatest care. From the mode in which the poison was applied, from the quantity employed, and from my prior experience, I should have entertained not the smallest doubt of the poison taking effect in every instance in less than twenty minutes, if no ligature had been applied. In two of the three, the quantity of woorara was more than had been used in any former experiments.

I have not judged it necessary to make any more experiments, with the ligature on the limb, because the numerous experiments of the Abbé Fontana on the ticunas, coincide in their results with those which have just been detailed, and fully establish the efficacy of the ligature in preventing the action of the poison. It is not to be wondered at, that the ligature should sometimes fail in its effects, since these must evidently depend on the degree in which the circulation is obstructed, and on the length of time during which the obstruction is continued.

There can be little doubt that the woorara affects the brain, by passing into the circulation through the divided vessels. It is probable that it does not produce its effects until it enters the substance of the brain, along with the blood, in which it is dissolved; nor will the experiments of the Abbé Fontana, in which he found the ticunas produce almost instant death when injected into the jugular vein of a rabbit, be found to militate against this conclusion, when we consider how short is the distance which, in so small an animal, the blood has to pass from the jugular vein to the carotid artery, and the great rapidity of the circulation; since in a rabbit under the influence of terror, during such an experiment, the heart cannot be supposed to act so seldom as three times in a second.

I have made no experiment to ascertain through what medium other poisons, when applied to wounds, affect the vital organs; but from analogy we may suppose that they enter the circulation through the divided blood-vessels.

The facts already related led me to conclude that alcohol, the

essential oil of almonds, the juice of aconite, the oil of tobacco, and the woorara, occasion death simply by destroying the functions of the brain. The following experiment appears fully to establish the truth of this conclusion.

Exp. 30.—The temperature of the room being 58 degrees of Fahrenheit's thermometer, I made two wounds in the side of a rabbit, and applied to them some of the woorara in the form of paste. In seven minutes after the application, the hind legs were paralysed, and in fifteen minutes respiration had ceased, and he was apparently dead. Two minutes afterwards the heart was still beating, and a tube was introduced through an opening into the trachea, by means of which the lungs were inflated. The artificial respiration was made regularly about thirty-six times a minute.

At first, the heart contracted one hundred times in a minute.

At the end of forty minutes, the pulse had risen to one hundred and twenty in a minute.

At the end of an hour, it had risen to one hundred and forty in a minute.

At the end of an hour and twenty-three minutes, the pulse had fallen to a hundred, and the artificial respiration was discontinued.

At the commencement of the experiment, the ball of a thermometer being placed in the rectum, the quicksilver rose to one hundred degrees; at the close of the experiment it had fallen to eighty-eight and a half.

During the continuance of the artificial respiration, the blood in the femoral artery was of a florid red, and that in the femoral vein of a dark colour, as usual.

It has been observed by M. Bichat, that the immediate cause of death, when it takes place suddenly, must be the cessation of the functions of the heart, the brain, or the lungs. This observation may be extended to death under all circumstances. The stomach, the liver, the kidneys, and many other organs, are necessary to life, but their constant action is not necessary; and the cessation of their functions cannot therefore be the immediate cause of death. As in this case the action of the heart had never ceased; as the circulation of the blood was kept up by artificial respiration for more than an hour and twenty minutes after the poison had produced its full effects; and as during this time the usual changes in the colour of the blood took place in the lungs; it is evident that the functions of

the heart and lungs were unimpaired: but that those of the brain had ceased, is proved by the animal having continued in a state of complete insensibility; and by this circumstance, that animal heat, to the generation of which I have formerly shewn the influence of the brain to be necessary, was not generated.

Having learned that the circulation might be kept up by artificial respiration for a considerable time after the woorara had produced its full effects, it occurred to me that in an animal under the influence of this or of any other poison that acts in a similar manner, by continuing the artificial respiration for a sufficient length of time after natural respiration had ceased, the brain might recover from the impression which the poison had produced, and the animal might be restored to life. In the last experiment, the animal gave no sign of returning sensibility; but it is to be observed, 1. That the quantity of the poison employed was very large. 2. That there was a great loss of animal heat, in consequence of the temperature of the room being much below the natural temperature of the animal, which could not therefore be considered under such favourable circumstances as to recovery, as if it had been kept in a higher temperature. 3. That the circulation was still vigorous when I left off inflating the lungs, and therefore it cannot be known what would have been the result, if the artificial respiration had been longer continued.

Exp. 31.—A wound was made in the side of a rabbit, and one drop of the essential oil of almonds was inserted into it, and immediately the animal was placed in a temperature of ninety degrees. In two minutes he was under the influence of the poison. The usual symptoms took place, and in three minutes more respiration had ceased, and he lay apparently dead, but the heart was still felt beating through the ribs. A tube was then introduced into one of the nostrils, and the lungs were inflated about thirty-five times in a minute. Six minutes after the commencement of artificial respiration, he moved his head and legs, and made an effort to breathe. He then was seized with convulsions, and again lay motionless, but continued to make occasional efforts to breathe. Sixteen minutes after its commencement, the artificial respiration was discontinued. He now breathed spontaneously seventy times in a minute, and moved his head and extremities. After this, he occasionally rose, and attempted to walk. In the intervals he continued in a dozing

state; but from this he gradually recovered. In less than two hours he appeared perfectly well, and he continued well on the following day.

The inflating the lungs has been frequently recommended in cases of suffocation, where the cause of death is the cessation of the functions of the lungs: as far as I know, it has not been before proposed in those cases, in which the cause of death is the cesssation of the functions of the brain. It is probable, that this method of treatment might be employed with advantage for the recovery of persons labouring under the effects of opium, and many other poisons.

III. GENERAL CONCLUSIONS.

The experiments which have been detailed lead to the following conclusions.

1. Alcohol, the essential oil of almonds, the juice of aconite, the empyreumatic oil of tobacco, and the woorara, act as poisons by simply destroying the functions of the brain; universal death taking place, because respiration is under the influence of the brain, and ceases when its functions are destroyed.

2. The infusion of tobacco when injected into the intestine, and the upas antiar when applied to a wound, have the power of rendering the heart insensible to the stimulus of the blood, thus stopping the circulation; in other words, they occasion syncope.

3. There is reason to believe that the poisons, which in these experiments were applied internally, produce their effects through the medium of the nerves without being absorbed into the circulation.

4. When the woorara is applied to a wound, it produces its effects on the brain, by entering the circulation through the divided blood-vessels; and, from analogy, we may conclude that other poisons, when applied to wounds, operate in a similar manner.

5. When an animal is apparently dead from the influence of a poison, which acts by simply destroying the functions of the brain, it may, in some instances at least, be made to recover, if respiration is artificially produced, and continued for a certain length of time."

We shall now proceed, from the long and formidable catalogue we collected above, to give some description of the growth and natural properties of the more curious poisonous plants.

[*Pantologia. Phil. Trans.* 1811.

SECTION II.

Cherry Laurel.

Prunus Lauro-cerasus.—LINN.

THE prunus genus embraces a very extensive family, amounting to not less than thirty one species, natives of Europe, Asia, and America, six of which are indigenous to our own country. To this genus belong the common plum tree, bullace, black-thorn, apricot with all its varieties, common cherry, common laurel, Portuguese laurel. To this also belongs the species before us, which is a shrub or small tree, sending off long spreading branches, and covered with smooth brown bark. Leaves evergreen, elliptical, or obovate, blunt, rather serrated, furnished with yellowish glands at the base, of a shining deep green, placed alternately upon strong short footstalks. Flowers on short peduncles, in spikes, which arise at the alæ of the leaves. Calyx tubular, ovate, divided at the brim into five pointed reflexed segments. Corolla composed of five petals, which are small, white, roundish. Filaments about eighteen, tapering, inserted in the calyx, furnished with simple antheræ. Germen oblong, supporting a columnar style, terminated by a blunt stigma. Flowers drupous, resembling a small cherry both in its external and internal structure.

It is a native of the Levant, and appears to have been long cultivated in Britain, and by its polished evergreen leaves adds much to the beauty of our shrubberies.

The leaves of the lauro-cerasus have a bitter styptic taste, accompanied with a flavour resembling that of bitter almonds, or other kernels of the drupaceous fruits. The flowers of this plant also manifest a similar flavour. The powdered leaves, applied to the nostrils, excite sneezing, though not so strongly as tobacco.

The kernel-like flavour which these leaves impart being generally esteemed grateful, has sometimes caused them to be employed for culinary purposes, and especially in custards, puddings, blanc-mange, &c. and as the proportion of this sapid matter of the leaf to the quantity of the milk is commonly inconsiderable, bad effects have seldom ensued. But as the poisonous quality of this laurel is

now indisputably proved, the public ought to be cautioned against its internal use.

The following communication to the Royal Society, by Dr. Madden of Dublin, contains the first and principal proofs of the deleterious effects of this vegetable upon mankind. " A very extraordinary accident that fell out here some months ago, has discovered to us a most dangerous poison, which was never before known to be so, though it has been in frequent use among us. The thing I mean is a simple water, distilled from the leaves of the lauro-cerasus.—The water is at first of a milky colour, but the oil which comes over the helm with it, being in a good measure separated from the phlegm, by passing it through a flannel-bag, it becomes as clear as common water. It has the smell of bitter almond, or peach kernel, and has been for many years in frequent use among our housewives and cooks, to give that agreeable flavour to their creams and puddings. It has also been much in use among our drinkers of drams; and the proportion they generally use it in, has been one part of laurel water to four of brandy. Nor has this practice, (however frequent) ever been attended with any apparent ill consequences, till some time in the month of September, 1728, when it happened that one Martha Boyse, a servant, who lived with a person that sold great quantities of this water, got a bottle of it from her mistress, and gave it to her mother, Ann Boyse, as a very rich cordial. Ann Boyse made a present of it to Frances Eaton, her sister, who was a shopkeeper in town, and who she thought might oblige her customers with it. Accordingly, in a few days, she gave about two ounces of the water to a woman called Mary Whaley, who drank about two-thirds of what was filled out, and went away. Frances Eaton drank the rest. In a quarter of an hour after Mary Whaley had drank the water, (as I am informed) she complained of a violent disorder in her stomach, soon after lost her speech, and died in about an hour, without vomiting or purging, or any convulsion.

The shopkeeper, F. Eaton, sent word to her sister, Ann Boyse, of what had happened; who came to her upon the message, and affirmed that it was not possible the cordial (as she called it) could have occasioned the death of the woman; and to convince her of it, she filled out about three spoonfuls, and drank it. She continued talking with F. Eaton about two minutes longer, and was so earnest

to persuade her of the liquor's being inoffensive, that she drank two spoonfuls more, but was hardly well seated in her chair when she died without the least groan or convulsion. Frances Eaton, who, as before observed, had drank somewhat above a spoonful, found no disorder in her stomach or elsewhere; but to prevent any ill consequence she took a vomit immediately, and has been well ever since."

Dr. Madden mentions another case of a gentleman at Kilkenny, who "mistook a bottle of this laurel water for a bottle of ptisan; what quantity he drank is uncertain, but he died in a few minutes, complaining of a violent disorder in his stomach."

In addition to this, we may refer to the unfortunate case of Sir Theodosius Boughton, whose death, in 1780, an English jury declared to be occasioned by this poison. In this case the active principle of the lauro cerasus was concentrated by repeated distillations, and given to the quantity of an ounce; the suddenly fatal effects of which must be still in the recollection of the public.

To brute animals this poison is almost instantaneously mortal, as amply appears by the experiments of Madden, Mortimer, Nicholls, Langrish, Vater, Fontana, and others.

The experiments, conducted by these gentlemen, shew, that the laurel-water is destructive to animal life, not only when taken into the stomach, but also on being injected into the intestines, or applied externally to different organs of the body. It is remarked by Abbé Fontana, that this poison, even "when applied in a very small quantity to the eyes, or to the inner part of the mouth, without touching the œsophagus, or being carried into the stomach, is capable of killing an animal in a few instants; whilst applied in a much greater quantity to wounds, it has so little activity, that the weakest animals, such as pigeons, resist its action."

The most volatile is the most active part of the lauro-cerasus; and if we judge from its sensible qualities, an analogous principle seems to pervade many other vegetable substances, especially the kernels of drupaceous fruits; and in various species of the amygdalus, this sapid principle extends to the flowers and leaves.

It is of importance to notice, that this is much less powerful in its action upon human subjects than upon dogs, rabbits, pigeons, and reptiles. To poison man the essential oil of the lauro-cerasus must be separated by distillation, as in the spirituous or common

laurel-water; and unless this is strongly imbued with the oil, or given in a large dose, it proves innocent.

Dr. Cullen observes, that the sedative power of the lauro-cerasus acts upon the nervous system in a different manner from opium and other narcotic substances, whose primary action is upon the animal functions: for the lauro-cerasus does not occasion sleep, nor does it produce local inflammation, but seems to act directly upon the vital powers. Abbé Fontana supposes that this poison destroys animal life, by exerting its effects upon the blood; but the experiments and observations from which he draws this opinion are evidently inconclusive. It may also be remarked, that many of the Abbé's experiments contradict each other.

Thus it appears, from the citation given above, that the poison of this vegetable, when applied to wounds, does not produce a fatal effect; but future experiments led the Abbé to assert, that the oil of the lauro-cerasus, "whether given internally, or applied to the wounds of animals, is one of the most terrible and deadly poisons known."

Though this vegetable seems to have escaped the notice of Stoerck, yet it is not without advocates for its medicinal use. Linnæus informs us, that in Switzerland it is commonly and successfully used in pulmonary complaints. Langrish mentions its efficacy in agues; and as Bergius found bitter almonds to have this effect, we may from analogy conclude, that this power of the lauro-cerasus is well established. Baylies found that it possessed a remarkable power of diluting the blood, and from experience recommended it in all cases of disease supposed to proceed from too dense a state of that fluid; adducing particular instances of its efficacy in rheumatism, asthma, and in schirrous affections. Nor does this author seem to have been much afraid of the deleterious quality of the lauro-cerasus, as he directs a pound of its leaves to be macerated in a pint of water, of which he gives from thirty to sixty drops three or four times a day.

[*Phil. Trans. Linn. Woodville.*

SECTION III.

Nightshade.

Solanum nigrum—LINN.
Solanum Dulcamara—LINN.
Atropa Belladonna—LINN.

THE vernacular term nightshade is applied to the above two species of solanum (the first being distinguished by the term *garden* nightshade, and the second by that of *woody* nightshade;) and the one species of atropa, which is peculiarly characterised by the term *deadly* nightshade. They are all medicinal under proper management, and poisonous when taken in excess.

1. *Atropa Belladonna.*—Deadly nightshade.

This has a thick, whitish, root, which is perennial, and sends forth strong, branched, annual, purple-coloured stems, from three to five feet high. The leaves are of unequal size, entire, oval, pointed, and stand in pairs upon short footstalks. The flowers are of a dark or brownish purple colour, large, pendent, bell-shaped, furrowed, and the limb cut into five segments. The whole plant is covered with fine hairs or down: the flowers appear in June or July, but the berries are not ripe till September, when they acquire a shining black colour. It grows in shady and stony waste grounds, but is not very common near London.

Whether this plant is the Στρυχνος μανικος of Dioscorides or not, botanists have not yet ascertained, but it has certainly been long known as a strong poison of the narcotic kind; and the berries, though less powerful than the leaves, furnish us with many instances of* their fatal effects, particularly upon children, who are readily

* Sennert. lib. vi. par. 7. cap. 9. Lobel Stirpium Adversa. p.103. Matthidus Oper. Omn. p. 754. Oetinger de Belladonna. Aug. Vindel. Strychnomania, &c. Bodaeus à Stapel. Comment. in Theophrast. 586. Simon Pauli Quad. Botan. p. 488. Gerard's Herbal, 341. Wepfer's Cicut. Aquat. Histor. et Noxæ, p. 228. Boulduc. histoire de l'Acad. a. 1703. Rossi Plant. Venen. p. 11. Boerhaave's hist. Plant. Lugd. Bat. hort. p. 510. Journ. de Med. ann. 1759. Gent. Magaz. 1747 and 1748. Hill's British Herbal, p. 329. Spielman's Diss. Veget. Venen. p. 16. Mapp. Pl. Alsat. p. 36. Murray's Apparat. Medicam. p. 431. Many other recent facts of the same kind might be adduced from various periodical publications. Ray found by applying the leaves of the Belladonna near the eye, a remarkable relaxation of the uvea was produced, and the oculists of the present day have in various cases availed themselves of this curious fact.—EDITOR.

tempted to eat this fruit, by its alluring appearance and sweet taste. The number of these berries necessary to produce deleterious effects, may probably depend upon the state of maturity in which they are eaten: if not more than three or four be swallowed, according to Haller's account, no bad consequence ensues; "Baccæ "sapore fatuo dulci possunt adsque noxa edi * si numerus tres "quatuorve non excesserit: plures etiam a studioso medicinæ "Coloniensi nomine Simonis vidi deglutiri †."

But when a greater number of the berries are taken into the stomach, scarcely half an hour elapses before violent symptoms supervene: viz. vertigo, delirium, great thirst, painful deglutition, and retching, followed by furor, stridor dentium, and convulsions; the eye-lids are drawn down, the uvea dilated and immovable; the face becomes red and tumid, and spasms affect the mouth and jaw: the general sensibility and irritability of the body suffer such great di-

Sauvages (*Nosol*) supposes that the Belladonna was the plant which produced such strange and dreadful effects upon the Roman soldiers, during their retreat (under the command of Anthony) from the Parthians; they are said to have "suffered great distress for want of provisions, and were urged to eat unknown plants: among others they met with an herb that was mortal; he that had eaten of it, lost his memory and his senses, and employed himself wholly in turning about all the stones he could find, and after vomiting up bile, fell down dead." Plutarch's life of Anthony.—The Scotch historian, Buchanan, relates that the Scots mixed a quantity of the juice of the Belladonna (Solanum Somniferum) with the bread and drink, which by their truce they were to supply the Danes with, which so intoxicated them, that the Scots killed the greatest part of Sweno's army while asleep. Lib. vii.

Ray relates a curious instance of the effects of this plant in the following words. Hist. Plant. p. 680. Accidit, ni fallor, tempore Pontificis Maximi Urbani ultimi, ut quidam de famulitio Cardinalis magni nominis (ut mihi hîc Augustæ retulit ejus hortulanus) infunderet in vino Malvatico herbam illam quam Bellam Donnam vocant, daturam alias per noctem ut ejus herbæ effectus discerent; infusum hoc propinarunt cuidam fratri mendicanti ex conventu S. Hieronymi, qui Patavii Fratrum ignorantiæ dicitur, a primo breve delirium, cachinni, gesticulationes variæ; dein insania vera, post stupor mentis qualis est ebriorum vigilantium. Cardinalis pro ebrio in carcere includit; deinde à medico qui rem subolfecerat innocens pronuntiatur, qui aceti cyatho propinato, a dementia quam Bella Donna causavit eum liberat. Hachstellerus Decad. 7 Ob.

And Shakespeare in his Macbeth makes Banquo say,

Or have we eaten of the insane root
That takes the reason prisoner.

* Hal. Stirp. Helv. No. 579.

† Hort. Florent. p. 62.

minution, that the stomach often bears large and repeated doses of tart. emet. (gr. 14.) without being brought into action; the pulse is small, hard, quick, and subsultus tendinum, risus sardonius et coma, generally precede death. The body being opened, inflammation has been discovered in the intestines, mesentery, and liver *. And Boulduc † found the stomach of a child eroded in three places. It may be necessary to remark, that vinegar, liberally drank, has been found very efficacious in obviating the effects of this poison; evacuations should however be always first promoted.

The leaves of the belladonna were first used externally to discuss scirrhous and cancerous tumours, and also as an application to ill conditioned ulcers; their good effects in this way at length induced physicians to employ them internally for the same disorders, and we have a considerable number of well authenticated facts which prove them a very serviceable and important remedy ‡. But it must likewise be confessed, that many cases of this sort have occurred in which the belladonna has been employed without success §: this, however, may be said of every medicine; and though Dr. Cullen repeatedly experienced its inefficacy, yet the facts he adduces in confirmation of the utility of this plant, are clear and decisive: " I have had a cancer of the lip entirely cured by it; a scirrhosity in a woman's breast, of such a kind as frequently proceeds to cancer, I have found entirely discussed by the use of it; a sore a little below

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* Comm. Nor. 1743, p. 61.

† Hist. de l'Acad. des Sc. de Paris, 1703, p. 56.

‡ Junker's Conspect. Ther. Gen. Ed. 1725. p. 491. Journ. de Med. ann. 1766. Timmermanns Progr. Mich. Albertus de Belladonna. Tib. Lambergen, stated in the Phil. Trans. vol. 50, by Mr Pultney. Comment. de Rebus, tom. 8, p. 654. Durlac Journ. de Med. t. 11, p. 449. Amoureux, l. c. tom. 13. p. 47. Marteau l. c. tom. 14, p. 11. van. den. Block. l. c. tom. 14, p. 108. Ludw. Advers. Pract. vol. 1, P. 4, p. 637, and vol 2. p. 314. To which we may add the later authorities of Bergius, (Mat. Med. p. 128, vol. 1.) and Murray, App. Med. vol. 1. p. 440. who used them successfully in convulsions and epilepsy. The good effects of the berries may be learned from Gesner, Epist. p. 34. Eph. N. C. ann. 3. Obs. 64. Smetius, lib. 4. p. 238. Mayerne Prax. Med. Syntagm. Alt. p. 136.

§ Heister Chirurgie, p. 328. Van. Der. Harr. *over de Knierknoest-en Kanker Gezwellen*, p. 85. Van. Dovern. in litt. ad Timmermann *Prog.* Timmerman Junr. ibid. Acrel. *Chir Handelser.* p. 40. De Haen Rat. Med. tom. 2. p. 45. Schmuckero Chirurg. Wahrnehmungen, tom. 2 p. 150. And some accounts given of this plant by our own countrymen Gataker and Bromfield.

the eye, which had put on a cancerous appearance, was much mended by the internal use of the Belladonna: but the patient having learned somewhat of the poisonous nature of the medicine, refused to continue the use of it, upon which the sore again spread, and was painful; but upon a return to the use of the Belladonna, was again mended to a considerable degree: when the same fears again returning, the use of it was again laid aside, and with the same consequence of the sore becoming worse. Of these alternate states, connected with the alternate use of, and abstinence from, the Belladonna, there were several of these alternations which fell under my own observation."

The sensible effects produced by the leaves of this plant taken in medicinal doses, are usually by the skin, kidnies, and sometimes by the intestinal canal: in larger doses troublesome dryness of the mouth and throat, giddiness, and dimness of sight are experienced.

That the advantages derived from the internal use of the Belladonna are only in proportion to the evacuations effected by it, is a conclusion we cannot admit as sufficiently warranted by the facts adduced upon this point.

As this plant is very uncertain in its operation, the proper dose is with difficulty ascertained: the most prudent manner of administering it is by beginning with one grain or less, which may be gradually increased according to its effects. Six grains are considered as a very large dose. With respect to the berries, so successfully employed as an anodyne, by Gesner and others, in dysenteries, a small spoonfull (coch. parvum) of a syrup of the juice was the dose given.

The root seems to partake of the same qualities as the leaves, but is less virulent.

2. *Solanum Dulcamara.*—Woody Nightshade.

The stalk is slender, climbing, alternately branched, somewhat angular, brittle, hollow, and frequently rises above six feet in height: it is covered with bark of an ash-colour, and that of the young branches is of a purple hue: the leaves are long, oval, pointed, veined, and many of those near the top are halbert-shaped, but the lower leaves are entire, and of a deep green colour: the flowers hang in loose clusters or cymæ; the corolla is monopetalous, wheel-shaped, divided into five pointed segments, which are bent backwards, of a purple colour, and the base of each marked with two

round green spots; the tube is short, and the faux or mouth is of a shining black colour; the calyx is small, and divides into five blunt persistent segments, of a purple colour; the five filaments are short, black, and inserted in the tube of the corolla: the antheræ are yellow, erect, and unite at their points; the style is somewhat longer than the stamina, and terminated by a simple obtuse stigma; the germen is oval, and becomes a roundish bilocular berry, which finally acquires a red colour, and contains many flat yellowish seeds. It grows plentifully in hedges well supplied with water, and the flowers appear about the latter end of June.

The roots and stalks of this Nightshade, upon being chewed, first cause a sensation of bitterness, which is soon followed by a considerable degree of sweetness; and hence the plant obtained the name of Bittersweet. The berries have not yet been applied to medical use; they seem to act powerfully upon the primæ viæ, exciting violent vomiting and purging: thirty of them were given to a dog, which soon became mad, and died in the space of three hours, and upon opening his stomach, the berries were discovered to have undergone no change by the power of digestion; there can therefore be little doubt of the deleterious effects of these berries; and as they are very common in the hedges, and may be easily mistaken by children for red currants, which they somewhat resemble, this circumstance is the more worthy of notice. The stirpites, or younger branches, are directed for use, in the Edinburgh Pharm. and they may be employed either fresh or dried, making a proportionate allowance in the dose of the latter for some diminution of its powers by drying. In autumn, when the leaves are fallen, the sensible qualities of the plant are said to be the strongest, and on this account it should be gathered in autumn rather than in spring.

Dulcamara does not manifest those narcotic qualities, which are common to many of the nightshades; it is however very generally admitted to be a medicine of considerable efficacy. Murray says that it promotes all the secretions; Haller observes that it partakes of the milder powers of the Nightshade, joined to a resolvent and saponaceous quality; and the opinion of Bergius seems to coincide with that of Murray.

3. *Solanum Nigrum.*—Garden Night-shade.

Root annual, branched, whitish, hung with numerous small fibres. Stalk above a foot in height, alternately branched, formed into angles by a foliaceous membrane, swelled at the base of each branch, rough, and of a dingy purple colour. Leaves on footstalks, alternate, irregularly ovate, sinuated, or indentated, and clothed with soft hairs. Flowers in a species of umbel, upon a common lateral flower-stalk. Calyx divided into five small short permanent segments. Corolla separated into five segments, which are oval, pointed, spreading, and of a whitish colour. Filaments five, short, downy, terminated by yellow oblong contiguous antheræ. Germen roundish, supporting a tapering downy style, furnished with a round stigma. Fruit a round two-celled berry, changing from a green to a black colour, and containing several kidney-shaped yellowish seeds.

It is common about rubbish, dunghills, and in neglected gardens, producing its flowers during all the summer months.

The smell of this plant is faint and disagreeable; to the taste it manifests no peculiar flavour, being simply herbaceous. It appears to possess the deleterious qualities of the other night shades in a very considerable degree; even the odour of the plant is said to be so powerfully narcotic as to cause sleep *.

The berries are equally poisonous with the leaves. Three children, upon eating them, were suddenly seized with cardialgia and delirium, accompanied with spasms, and remarkable distortions of the limbs †: and to poultry they proved fatal in a short time ‡.

The plant, or rather the leaves which were boiled and eaten by a mother and four children, produced swellings of the face and limbs, followed by inflammation and gangrene; but the husband, who likewise ate of this vegetable at the same time, found no consequent disorder §.

Its deleterious effects appear still more certain from the experiments of Messrs. Gataker and Bromfield; the latter asserts that in doses of one grain it had a mortal effect upon one of his patients ‖.

* Boccone. Museo di fis. p. 284. † Vide Wepfer De cicut. p. 226.
‡ Haller, l. c. § Rucker. Commer. Noric. 1731, p. 372.
‖ It ought to be remarked, however, that Dioscorides and Theophrastus mention it as an esculent plant; and Guerin (De vegetat. venen. Alsatiæ, 1766,

As this species of night-shade is thought to be the Στρυχνος κηπαῖος of Dioscorides *, its external use was resorted to in ancient times as a discutient and anodyne in various affections of the skin, tumefactions of the glands, ulcers, and disorders of the eyes; nor does the utility of this practice want the confirmation of later experience †.

Of its internal use we find very little evidence in the writings of the ancients; though, according to Cæsalpinus ‡, it appears not to have been wholly neglected.

Its medicinal powers in modern times appear to be equally doubtful. Gataker strongly recommended it, externally and in solution as an excellent restorative lotion for old sores and cancerous ulcers, &c. and internally as an aperient and good diuretic: but Bromfield was never able to obtain these effects in any sufficient degree.

[*Dioscorid. Linn. Wepfer. Lewis. Woodville.*

SECTION IV.

Black Henbane.

Hyoscyamus Niger.—LINN.

THERE are eight species of henbane, chiefly natives of the Levant and Palestine; but the one before us is also common to our own country. The root is biennial, long, compact, white, and beset with many fibres: the stalk is erect, round, woody, branched, and rises about two feet in height: the leaves are large, cut into irregular lobes or pointed segments, of a sea-green colour, undulated, woolly, and at their bases embrace the stem: the flowers are produced in irregular clusters at the tops of the branches; they are

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p. 66,) relates that he drank an infusion of fifteen grains of the solanum nigrum without suffering any consequent complaint; and that an epileptic patient took from half a dram to two drams of the expressed juice of the plant, without perceiving any narcotic symptom to follow; nor with some soldiers, to whom a still larger dose was given, together with two drams of the juice of the berries, was any other effect produced than that of an increased quantity of urine. See Murray, l. c.

* Mat. Med. lib. 4, c. 71.

† With the Arabians it is a common application to burns and ulcers. See Forskol. Descript. Plant. c. 2, p. 46. Ray also speaks highly of its effects in indurations of the breast. See Hist. l. c.

‡ De Plant. 213.

funnel-shaped, consisting of a short tube, with an expanded limb, which is divided into five obtuse segments, of an obscure yellow colour, and beautifully painted with many purple veins: the calyx is divided into five short pointed downy segments: the five filaments are tapering, downy at the base, inserted in the tube of the corolla, and furnished with large oblong antheræ: the germen is roundish: the style slender, longer than the stamina, and terminated by a blunt stigma: the capsule is oval, marked with a line on each side, and divided into two cells, which contain many small irregular brown seeds. It is a native of England, and grows commonly amongst rubbish, about villages, road-sides, &c. and flowers in June.

The smell of hyoscyamus is strong and peculiar, and the leaves, when bruised, emit somewhat of the odour of tobacco. This smell is still stronger when the leaves are burnt; and on burning they sparkle with a deflagration, somewhat resembling that of nitre, but to the taste they are mild, and mucilaginous." Henbane is a powerful narcotic poison, and many instances of its deleterious effects are recorded by different authors.

Out of the many instances of this kind, we shall only advert to some of them, in order to shew that the roots, seeds, and leaves of this plant, have separately produced poisonous effects. Dr. Patouillat, physician at Toucy in France, relates * that nine persons, in consequence of having eaten the roots of the hyoscyamus, were seized with most alarming symptoms; "some were speechless, and shewed no other signs of life than by convulsions, contortions of their limbs, and the risus sardonicus; all having their eyes starting out of their heads, and their mouths drawn backwards on both sides; others had all the symptoms alike; however, five of them did now and then open their mouths, but it was to utter howlings. The madness of all these patients was so complete, and their agitations so violent, that in order to give one of them the antidote, I was obliged to employ six strong men to hold him while I was getting his teeth asunder to pour down the remedy." And what is remarkable, Dr. P. says, that on their recovery, all objects appeared to them as red as scarlet, for two or three days †.

* Phil. Trans. vol. 40, p. 446.

† Further accounts of the effects of these roots are given by Wepfer de Cicut, &c. p. 230. Simon Pauli Quadr. p. 384. Blom. in Vet. Ac. Handl. 1774. p. 52.

Respecting the seeds of henbane, we have an account given by Sir Hans Sloane *, of four children who ate them by mistaking the capsules, in which they were contained, for filberts. "The symptoms that appeared in all the four were great thirst, swimmings of the head, dimness of sight, ravings, profound sleep, which last in one of the children continued two days and nights †."

The leaves of hyoscyamus, we are told, were boiled in broth, and eaten by seven persons, (five men and two women) who soon became affected with symptoms of intoxication. Dr. Stedman says, "I saw them about three hours after having eat it; and then three of the men were become quite insensible, did not know their comrades, talked incoherently, and were in as high a delirium as people in the rage of a fever. All of them had low irregular pulses, slavered, and frequently changed colour: their eyes looked fiery, and they catched at whatever lay next them, calling out that it was going to fall ‡."

Henbane is poisonous to birds and dogs; but horses, cows, goats, and swine, it does not affect.

There cannot be a doubt, however, that this plant, like others of the same natural order, under proper management, may be safely employed, and be found in many cases to be an active and useful remedy. Hyoscyamus was well known to the ancients, and its effects as an anodyne were experienced by Dioscorides; and with this intention it has been used both internally and externally by several subsequent writers, particularly by Celsus; and in hæmorrhagic diseases the sem. hyoscyami were successfully given by Plater, Forestus, and Boyle.

It appears, however, that for a long time past the employment of henbane, in the practice of medicine, was wholly laid aside, till Baron Stoerck published several cases of different diseases, in which an extract, prepared from the juice of this plant, had been discovered to be an efficacious remedy. These diseases are stated by the Baron to be internal spasms and convulsions, palpitations of the heart, madness, melancholy, epilepsy, inveterate head-aches, hæ-

* Phil. Trans. vol. 38, p. 99.

† See also Essays and Observations, phys. et lit. vol. 2, p. 243. Helmont. Ort. Med. p. 306. Ephemer. Germ. annis 7 et 8, &c.

‡ Phil. Trans. vol. 47, an. 1750. For additional facts see Haller, l. c. Spielmanni Diss. de veget. ven. Alsat.

moptysis; and a troublesome cough, which accompanied the last-mentioned complaint, was completely appeased by the repeated use of the extract, which in several disorders was often found to produce sleep more powerfully than opium. The success of hyoscyamus in these cases, (many of which were said to be of long duration, and to have resisted the effects of other remedies) is also confirmed by Collin, who extended the dose of the extract. hyoscyami, to twenty-four or thirty grains per diem. But from the experiments made of this medicine by Greeding, who tried it in forty cases of melancholia, mania, and epilepsia, the result was very different: yet while his practice shews that no benefit is to be expected in these three diseases, it tends to prove that this medicine is a useful anodyne; and as it usually opens the body, it may be advantageously substituted for opium, where the astringency of the latter becomes an objection to its use. Dr. Cullen says, "that in epilepsy, and various convulsive affections, for which Baron Stoerck particularly recommends the extract of henbane, we have very frequently employed it, but have never found it of any great virtue, nor of more than what we have found in opium. We have, indeed, found the hyoscyamus to be often an agreeable anodyne and soporiferous medicine; and we have frequently found it such in persons who, from particular circumstances, did not agree with opium, and particularly because it was less binding to the belly than opium. We judge, however, that it is more ready in full doses to give delirium than opium is, and therefore we found it in many cases to give turbulent and unrefreshing sleep; and notwithstanding its laxative qualities, for which we had employed it, we have been obliged to lay it aside." Stoerck and some others recommend this extract in the dose of one grain or two; but Dr. Cullen observes, that he seldom discovered its anodyne effects till he had proceeded to doses of eight or ten grains, and sometimes to fifteen, and even to twenty.

The leaves of henbane are said to have been applied externally with advantage in the way of poultice, to resolve scirrhous tumours, and to remove some pains of the rheumatic and arthritic kind.

[*Haller. Phil. Trans. Lewis. Woodv.*

SECTION V.

Thorn Apple.

Datura Stramonium.—LINN.

THIS is found in the wastes of our own country, with spinous, erect, ovate, labrous leaves. It rises about a yard high, with a strong, perpendicular round hollow stalk, branching luxuriantly and to a great extent. At night the upper leaves become erect, and inclose the flowers, which have sometimes a tinge of purple or violet: the flowers consist of a single funnel-shaped petal.

This plant has been long known as a powerful narcotic poison; its congener, the D. Metel, is thought to be Στρυχνος μανικος of Theophrastus and Dioscorides, and is therefore the species received by Linnæus into the Materia Medica. The stramonium, in its recent state, has a bitterish taste, and a smell somewhat resembling that of poppies, or as called by Bergius, narcotic, especially if the leaves be rubbed betwixt the fingers. By holding the plant to the nose for some time, or sleeping in a bed where the leaves are strewed, giddiness of the head and stupor are said to have been produced.

Instances of the deleterious effects of this plant are numerous, especially of the seeds, some of which we shall relate, for the purpose of stating the symptoms which they produce. A man, aged sixty-nine, labouring under a calculous complaint, by mistake boiled the capsules of the stramonium in milk, and in consequence of drinking this decoction was affected with vertigo, dryness of the fauces, anxiety, followed with loss of voice and sense; the pulse became small and quick, the extremities cold, the limbs paralytic, the features distorted, accompanied with violent delirium, continual watchfulness, and a total suppression of all the evacuations; but in a few hours he was restored to his former state of health.

Every part of the plant appears to possess a narcotic power, but the seeds are the only part, of whose fatal effects we find instances recorded. Their soporiferous and intoxicating qualities are well known in eastern countries; and, if we can credit the accounts of some authors, have been converted to purposes the most licentious and dishonourable. The internal use of stramonium, as well as that

of several other deleterious plants which we have had occasion to notice, was first ventured upon and recommended by Baron Stoerck, who gave an extract prepared of the expressed juice of the plant, with advantage, in cases of mania, epilepsy, and some other convulsive affections. But as the success of this plant, even in the hands of the Baron, was not remarkable enough to claim very extraordinary praise, his account of the efficacy of the stramonium probably would not have procured it a place in the Materia Medica of the Edinburgh Pharmacopœia, had its character rested solely upon his representation. Odhelius tells us, that of fourteen patients suffering under epileptic and convulsive affections, to whom he gave the stramonium in an hospital at Stockholm, eight were completely cured, five were relieved, and only one received no benefit. Bergius relates three cases of its success, viz. one of mania, and two of convulsions. Reef, a Swedish physician, mentions its utility in two cases of mania. Wedenberg cured four girls, affected with convulsive complaints, by the use of this medicine. Other instances of the kind might be added. Greding, however, who made many experiments, with a view to ascertain the efficacy of this plant, was not so successful; for out of the great number of cases in which he employed the stramonium, it was only in one instance that it effected a cure; and he objects to the cases stated by Dr. Odhelius, on the ground that the patients were dismissed before sufficient time was allowed to know whether the disease would return again or not. In this country we are unacquainted with any practitioners whose experience tends to throw any light on the medical character of this plant. It appears to us, that its effects as a medicine are to be referred to no other power than that of a narcotic: and Dr. Cullen, speaking on this subject, says, "I have no doubt that narcotics may be a remedy in certain cases of mania and epilepsy; but I have not, and I doubt if any other person has, learned to distinguish the cases to which such remedies are properly adapted. It is therefore that we find the other narcotics, as well as the stramonium, to fail in the same hands in which they had in other cases seemed to succeed. It is this consideration that has occasioned my neglecting the use of stramonium, and therefore prevented me from speaking more precisely from my own experience on this subject."

The extract of this plant has been the preparation usually employed, and from one to ten grains and upwards, a day; but the

powdered leaves, after the manner of those directed of hemlock, would seem, for the reason there given, to be a preparation more certain and convenient. Greding found the strength of the extract to vary exceedingly; that which he obtained from Ludwig, was a much more powerful medicine than that which he had of Stoerck.

Externally the leaves of stramonium have been used as an application to inflammatory tumours and burns; in the latter a remarkable instance is noticed by Gerard.

The leaves have lately been dried and smoked as a remedy for the asthma; in many cases there has been evident advantage. But so far as our observations have extended, the plant loses this part of its benefit by use: the patient who has smoked it for some months, or even weeks, no longer finding his respiration improved hereby.

[*Woodville. Fowler. Ludwig. Editor.*

SECTION VI.

Vomic Nut.

Strychnos Nux Vomica.—LINN.

THIS is a large tree which sends off numerous strong branches, covered with dark grey smooth bark. The young branches have swelled articulations, or a knotty jointed appearance, scandent, and covered with bark of a dark green colour. The leaves arise at the joints in pairs, upon short footstalks, and are ovate, broad, pointed, entire, with three or five ribs, and on the upper side of a shining green colour. The flowers terminate the branches in a kind of fasciculated umbel. Calyx small, tubular, five toothed. Corol monopetalous: tube cylindrical, or rather inflated at the middle, very long, and at the limb cut into five small ovate segments. Filaments five, short, fixed at the mouth of the tube, and furnished with simple anthers. Germ roundish, supporting a simple style, terminated by a blunt stigma. Fruit a round smooth large pulpy berry, externally yellow, and containing round depressed seeds, covered with downy radiated hairs.

It is a native of the East Indies, and, according to the Hortus Kewensis, was introduced into England in 1778, by Dr. Patrick

Russell; but it has not yet been cultivated with success in this country.

The nux vomica, lignum colubrinum, and faba sancti Ignatii, have been long known in the Materia Medica as narcotic poisons, brought from the East Indies, while the vegetables which produced them were unknown, or at least not botanically ascertained.

By the judicious discrimination of Linnæus, the nux vomica was found to be the fruit of the tree described and figured in the Hortus Malabaricus under the name Caniram, since called Strychnos. To this genus also, but upon evidence less conclusive, he likewise justly referred the colubrinum. But the faba sancti Ignatii he merely conjectured might belong to this family, as appears by the query *an Strychni species?* which subsequent discoveries have enabled us to decide in the negative; for in the Supp. Plant. it constitutes the new genus *Ignatia*, which Loureiro afterwards confirmed, changing the specific name *amara* to that of *philippinica*. The strychnos and ignatia are, however, nearly allied, and both rank under the order solanaceæ.

We have thought it necessary to inquire thus far into the botanical origin of these productions, from finding that by medical writers they are generally treated of under the same head, and in a very confused and indiscriminate manner.

The seed of the fruit or berry of this tree is the officinal nux vomica: it is flat, round, about an inch broad, and near a quarter of an inch thick, with a prominence in the middle on both sides, of a grey colour, covered with a kind of woolly matter, and internally hard and tough like horn; to the taste it is extremely bitter, but has no remarkable smell. It consists chiefly of a gummy matter, which is moderately bitter; the resinous part is very inconsiderable in quantity, but intensely bitter; hence rectified spirit has been considered its best menstruum.

Nux vomica is reckoned amongst the most powerful poisons of the narcotic kind, especially to brute animals, nor are instances wanting of its deleterious effects upon the human species. It proves fatal to dogs in a very short time, as appears by various authorities. Hillefeld and others found that it also poisoned hares, foxes, wolves, cats, rabbits, and even some birds, as crows and ducks; and Loureiro relates that a horse died in four hours after taking a dram of the seed in an half-roasted state. The effects of this baneful drug

upon different animals, and even upon those of the same species, appear to be rather uncertain, and not always in proportion to the quantity of the poison given. With some animals it produces its effects almost instantaneously; with others not till after several hours, when laborious respiration, followed by torpor, tremblings, coma, and convulsions, usually precede the fatal spasms, or tetanus, with which this drug commonly extinguishes life.

From four cases related of its mortal effects upon human subjects, we find the symptoms corresponded nearly with those which we have here mentioned of brutes; and these, as well as the dissections of dogs, killed by this poison, not shewing any injury done to the stomach, or intestines, prove that the nux vomica acts immediately upon the nervous system, and destroys life by the severity of its narcotic influence.

The quantity of the seed necessary to produce this effect upon a strong dog, as appears by experiments, need not be more than a scruple: a rabbit was killed by five and a cat by four grains: and of the four persons to whom we have alluded, and who unfortunately perished by this deleterious drug, one was a girl ten years of age, to whom fifteen grains were exhibited at twice for the cure of an ague. Loss, however, tells us, that he took one or two grains of it in substance without discovering any bad effect; and that a friend of his swallowed a whole seed without injury.

In Britain, where physicians seem to observe the rule *saltem non noscere*, more strictly than in many other countries, the nux vomica has been rarely if ever employed as a medicine. On the continent, however, and especially in Germany, they have certainly been guided more by the axiom "what is incapable of doing much harm, is equally unable to do much good." The truth of this remark was lately very fully exemplified by the practice of Baron Stoerck; and is farther illustrated by the medicinal character given of nux vomica, which, from the time of Gesner till that of a modern date, has been recommended by a succession of authors, as an antidote to the plague, as a febrifuge, as a vermifuge, and as a remedy in mania, hypochondriasis, hysteria, rheumatism, gout, and canine madness. In Sweden it has of late years been successfully used in dysentery; but Bergius, who tried its effects in this disease, says, that it suppressed the flux for twelve hours, which afterwards returned again. A woman, who took a scruple of this drug night and morn-

ing, two successive days, is said to have been seized with convulsions and vertigo, notwithstanding which, the dysenteric symptoms returned, and the disorder was cured by other medicines; but a pain in the stomach, the effect of the nux vomica, continued afterwards for a long time. Bergius, therefore, thinks it should only be administered in the character of a tonic and anodyne in small doses, (from five to ten grains) and not till after proper laxatives have been employed.

Loureiro recommends it as a valuable internal medicine in fluor albus; for which purpose he roasts it till it becomes perfectly black and friable, which renders its medicinal use safe, without impairing its efficacy.

[*Gesner. Wepfer. Junghanns. Woodville.*

SECTION VII.

Manchineel-tree.

Hippomane manicella.—LINN.

THERE are three species of the Hippomane, of which the one here referred to has leaves ovate, serrate, with two glands at the base. The milky juice of this tree is highly poisonous, and was at one time in frequent use among the Indians as a poison for the tips of their arrows. The poisonous property pervades nearly equally the fruit and the wood. Hence the incautious traveller, tempted by the appearance of the first, has often fallen a victim to the violence of its morbid stimulus: for the poison seems to depend on a peculiar acrimony alone; and hence also the fellers of the timber, which on account of the closeness and beauty of its grain is in much esteem among our cabinet-makers, are compelled to dry the trunk by making fires around it, before they attempt to fell it; while the sawyers find it requisite to blind their eyes while sawing, to avoid ophthalmic inflammations, which the pungent aroma that flies about them is otherwise sure to produce. If the juice of this tree touch the skin, it generally blisters it; and if it fall on linen, it corrodes it like vitriolic acid, the spotted parts turning black, and terminating in holes. This is a West indian tree.

The manchineel tree affords furniture for slabs, interspersed with beautiful green and yellow veins like marble; but the dust of the

wood is of so acrid and poisonous a nature, that the sawyers and carpenters are obliged to work with gauze masks, to protect them from its injurious effects.

Historians have, however, exaggerated the accounts they have given of the poisonous nature of this tree; for it has been said, that the heads of the persons who sleep under its shade swell, and they become blind; that if the leaves touch but the naked skin, they raise pustules, which cause deadly pains, unless helped with water and salt, or fasting spittle. This, however, is not true; nor is any ill consequence to be feared from the leaves touching the naked body, unless they are bruised, and the white milky juice they contain is suffered to pervade the pores; when it does, it raises blisters like those of the confluent kind of the small-pox, causing acute pains; but simple drops of rain water falling from those leaves upon the skin will not have any ill effect, which Mr. Hughes affirms he has experienced upon repeated trials.

"This tree", observes the same writer "is of a very quick growth, and is seldom or never found growing to any perfection but in a loose and sandy soil, near the sea or other water. The trunk, when full grown, is generally from two feet and a half to three feet in diameter, branching, most commonly, from three to fifteen feet high from the ground. The grain is smooth, and the wood durable. It bears a fruit of the same make as the round sort of crab-apple, and in its branches is of a beautiful colour and fragrant smell. The pulp of these manchineel apples does not exceed one seventh of an inch in depth, the inside being a hard stony kernel, in which are included the seeds. Formerly no one dared to cut down these trees, without first having made a large fire round them, in order to burn the bark and dry up the juices that proceed from them in cutting: but now naked negroes venture to cut them down, only using the precaution of rubbing their whole bodies with lime-juice, which prevents the sap from corroding or ulcerating their skins. Bruising and mashing the tender leaves and boughs, and then throwing them into fish-ponds, has often been practised by villains to destroy the fish, which soon after grow stupid, float with their bellies upward on the top of the water, and frequently die. Some sorts of fish will eat these apples; these are often found dead in the water, and if taken while alive and eaten, often prove poisonous; even the large white crab that burrows in the sand, is not, if near these trees

to be used for food. It is extremely remarkable that wherever a manchineel-tree grows there is found either a white wood, or a fig-tree near it, the juice of either of which is an infallible antidote against the poison; salt water is no less efficacious; and as these trees grow by the sea-side, this remedy is also near at hand."

[*Pantologia. Martins. Hispaniola. Editor.*

SECTION VIII.

Lamas and Ticunas.

Mons. de la Condamine, on his return from the voyage which he made in the interior parts of South America, from the coast of the South Sea to the coasts of Brazil and Guiana, by going down the river of the Amazons, brought to Paris a small quantity of a very dangerous poison, much in use among the Indians of Lamas*, Ticunas, Pevas, and also among the Yameos, who all extract it by fire from divers plants, especially from certain plants which the French call *lianes*.

Those savages are very dexterous at making long tubes, which are the most common weapons used by the Indians for hunting. To these they fit little arrows made of the palm tree, on which they put a small roll of cotton, that exactly fills the bore of the tube. They shoot them with their breath, and seldom or never miss the mark. This simple instrument advantageously supplies the defect of fire-arms among all those nations. They dip the points of these little arrows as well as those of their bows, in this poison; which is so active that in less than a minute, especially when fresh, it kills certain animals, from which the arrow has drawn blood.

* Lamas is a Spanish village, or little town, in Upper Peru, situated in about 7° of south latitude, to the west of the river of Guallaga. The native Indians of this district prepare a famous poison for poisoning arrows, different from that of the Yameos, Pevas, and Ticunas, Indian nations on the borders of the river of the Amazons, towards the mouth of the Napo, in 3° or 4° of south latitude. The poison of Ticunas is the most famous of all for its activity. They say, that that of Lamas sooner looses its force, but that it is more proper for certain animals than that of Ticunas. And it is the common opinion, that that of Lamas, being mixed with that of Ticunas, becomes more violent and active by the mixture.—Orig.

Mons. de la Condamine says, in the abridged account of his voyage, that "when he arrived at Cayenne, he had the curiosity to try whether this poison, which he had kept above a year, still retained its activity: and at the same time whether sugar was really as efficacious a counter poison as he had been assured. Both the experiments were performed, he says, in presence of the commandant of the colony, of several officers of the garrison, and of the King's physician. A hen, slightly wounded with one of these little arrows, the point of which had been dipped in the poison thirteen months at least before the trial, blown through a trunk, lived half a quarter of an hour: another, pricked in the wing with one of these arrows, newly dipped in this poison diluted with water, and immediately drawn out of the wound, seemed to dose a minute after; convulsions soon came on, and, though we had made her swallow some sugar, she expired. A third, pricked with the same arrow, dipped again into the poison, having been instantly assisted by the same remedy, shewed no signs of being indisposed, &c."

Mons. Herrissant was struck with amazement on reading these facts: but his surprise was soon followed by a desire of repeating those experiments himself, and even of trying them on different sorts of animals. Mons. de la Condamine, to whom he imparted his intention, offered to satisfy his curiosity, and for that purpose made him a present of a certain quantity of this poison; and the result of the experiments, which he made with this same poison, forms the subject of this memoir.

He begins the detail of those experiments by that of two accidents, which had like to have disabled him from prosecuting the work he had undertaken; having very narrowly escaped death. The first accident happened thus: M. de la Condamine had forewarned him, that when the Indians designed to use their poison, which in colour, consistence, and even in smell, has a great deal of resemblance to Spanish liquorice, they dissolved it in water, and then evaporated it on a slow fire to the consistence of a soft extract. M. Herrissant made this preliminary preparation in a small closet, in which a young lad was actually at work; and he did not think of making him quit it, because he did not imagine, that the poison, of which he intended to make trial, could produce any bad effects, without being introduced into the blood by the opening of a wound. Nor did he then recollect, what M. de la Condamine had told him;

which is, that while they are preparing this poison in the country, they oblige some criminal old woman to take care of the boiling of this poison, after shutting her up alone in a separate place; so that when this woman dies, it is a sign that the poison is sufficiently boiled, and that it has all the qualities requisite to make it good. But he was soon made sensible of his imprudence; the door of the closet, where the young lad above mentioned staid, was open; and from the next chamber he saw that the lad, who had been there about three quarters of an hour, sat still, with his arms across. He began to reprimand him for his laziness, but he excused himself by answering, with a trembling voice, that he was sick at heart, and felt himself very faint. It is easy to imagine the uneasiness which this sight gave M. H.; but luckily it cost him no more than the fright. He made the lad come out of the closet immediately, let him down into the yard, and made him swallow a pint of good wine, in which he had dissolved a quarter of a pound of sugar. He recovered his strength by degrees, and was soon able to return to his own home, very merry and happy, without the least notion of the danger he had been in. Some days afterwards he came to M. H. and assured him that he had not felt the least indisposition since the day in question.

The fact above related was shocking enough to have made M. H. abandon his project; however curiosity got the better of his fear, and he even took a strong fancy to repeat the experiment. It would have been inhuman, not to say criminal, to make it on any other person but himself; therefore he resolved to run the risk, or rather persuaded himself, that he should run none, because he should be timely enough to flee from the danger, as soon as the effect of the poison should come to a certain pitch. Besides, he was encouraged by the good success of the foregoing example. Therefore he disposed every thing as at the first time, and he stayed in the closet. In about an hour's time he perceived his legs to bend under him, and his arms became so weak, that he could scarcely use them. He had but just time enough to come quickly out of the closet, and get down into the yard; where he ordered wine and sugar to be brought him, as he had before done for the young lad. Such was the first danger, which he incurred in preparing the American poison: the second was not inferior to it.

After having dissolved the poison of Ticunas in water, and re-

duced it to the consistence of an extract in the manner above described, he put it into a phial, which he stopped very exactly, and locked up in a desk till he should have occasion to use it in the experiments he intended to make. He began these experiments on the 6th of June, 1748; which was so hot a day, that he stripped to his shirt, and had his breast and arms exposed to the air. In his left hand he held the phial, the cork of which flew up to the ceiling with vast rapidity. At the same instant there issued out of this phial a yellowish vapour, of a very penetrating smell, which was soon followed by the extract itself, that spread itself all over the rim of the neck of the bottle. He was so stupified at this unexpected accident, that he imagined (as it was very possible) that the bottle was broken in pieces; and as soon as he saw his hands, arms and breast, coloured in several places by the poison, which had besprinkled them in the explosion, he looked on himself as a dead man: which must certainly have been the case, if the bottle had burst, and the pieces of glass had scratched or cut him. But luckily that did not happen, and he soon resumed courage; when, after some minutes, he found himself quite as well as before the explosion of the poison; the effect of which is almost instantaneous; and it gave him no other trouble than to wash and dry himself very carefully.

From this accident he learned that this poison, thus prepared, ought not to be put into glass bottles close stopped, but should rather be kept in a glazed earthen pot, covered with paper only; since it was susceptible of so great an effervescence. Therefore he put it into a gallypot; and the experiments, which he made with this same poison a good while afterward, convinced him that there is no reason to apprehend that it would lose any of its activity by evaporation. These two facts plainly shew how much precaution ought to be taken, when this poison is to be used. And we shall be the better convinced of it when we consider, that one single drop conveyed directly into the blood by a puncture, &c. is sometimes sufficient to kill, or at least to cause great disturbance in the animal œconomy. It is quite otherwise when taken in at the mouth; for then it does no sort of mischief, as he proves in another place.

He then proceeds to the experiments, which he had repeated a number of times on different species of quadrupeds, birds, fishes, insects, and reptiles. But he first observes, that, of all those ani-

mals, none but quadrupeds and birds were killed by this poison, as will more particularly appear by the journal of his experiments: the others, viz. the fishes *, the insects †, and the reptiles ‡, were not killed, though several of them seemed to be disordered by it.

M. H. had verified what M. de la Condamine says, in the account of his voyage, relating to the use that may be made of animals killed by this poison, without apprehending any ill consequences to those who eat of them. In effect he had eaten rabbits, which he had killed with this poison, and afterwards made several other persons eat of them; and no one perceived the least indisposition.

On the 6th of June, 1748, M. H. made a small wound, of about three lines long, in the left hinder leg of a rabbit six months old: into this wound he put a bit of cotton soaked in the poison of ticunas: the creature died suddenly in his hands, without giving the least indication of having felt pain, and even before he could apply a bandage to the wound. The same day he repeated this experiment on eight other rabbits, and on four dogs: they all died in about a minute.

The 7th of June of the same year he dipped the point of a lancet into the poison; and with this instrument he pricked four cats and two rabbits, some in the head and the others in the paw, dipping the lancet each time that he pricked an animal. The rabbits died in as short a time as the preceding day; but the cats held out about three minutes.

The same day he made a small wound, about two lines long, in the right hinder leg of a rabbit, and put into it a small pledget of cotton soaked in the extract of opium diluted in a little spirit of wine; but this did not cause any disorder in the creature; nor did arsenic, which he applied to another in the same manner. In fine, to a third he made use of the extract of white hellebore, and he perceived that this animal became restless, nearly as he had observed in the animals that died by the effect of the poison of ticunas. However, this rabbit did not die, but fell into a sudden fit of fury, which went off in about eight minutes. He had likewise made trial of this extract on other rabbits, dogs, and cats; and the effect

* Those which M. H. employed, were the carp, the eel, the pike, the gudgeon, the barbel, and the tench.—Orig.

† As caterpillars, bees, different flies of two and four wings, the grillotalpa, butterflies, May-flies.—Orig.

‡ For example, earthworms, vipers, snakes.—Orig.

was the same, more or less. Of all the extracts which he employed, as for example those of henbane, night-shade, tobacco, &c. he found none but that of white hellebore that seemed to raise some little disorder in the animal economy. The essential oil of the laurocerasus did not incommode the animals, into whose mass of blood he conveyed it, instead of the poison.

The 8th of June, with a lancet he made a very small incision between the ears of a cat, and with a pencil he put into it a drop of the poison of ticunas mixed with that of lamas: in an instant the creature died between his hands.

June the 9th, he put some of the same poison into small wounds, which he made in different parts of insects, reptiles, fishes; and not one of them died of it.

The same day he made a wound that penetrated into the cavity of the abdomen of a large cat, without hurting any of the contained parts; and, with a crotchet holding up the integuments, to keep them from touching the abdominal viscera of this animal, that lay on its back, he introduced the end of a funnel, and through it poured into the cavity of the abdomen about half a dram of the poison of lamas mixed with that of ticunas. By this management he intended that the edges of the wound should not be wetted with the poison, and that it should touch nothing but the surface of the abdominal viscera. He made a suture of one stitch to join the lips of the wound, and he kept the integuments constantly suspended, to prevent their touching the poison: and in this he was certain that he succeeded. At first the creature did not seem to suffer much from this operation; but in an hour's time he died, with such violent convulsions in his throat, that it was almost impossible for him to breathe.

June the 10th, he pricked with a lancet the left fore leg of a large fat cat, and put in a drop of the poison of the ticunas. He let this animal run loose about the room, without dressing the wound. By the time he had made a turn round the room, he seemed very restless and timorous; his legs failed him; he lay flat on his belly; and the skin all over his body trembled considerably; the hair of his tail stood up, and his paws were agitated with a frightful tremor. All this while the animal made no noise: in fine, his head fell all at once between his fore legs, and he died in four minutes after the insertion of the poison.

June the 12th, he made the same experiment on two other cats, and on three dogs; these animals seemed to fall sick almost in an instant: the cats had their hair bristled up, and their bodies gathered into a heap: they scratched the ground with their fore feet. The dogs did the same, and all of them had a languishing look, and their eyes bathed in tears; some of them looked at him stedfastly, and made a mournful noise: they were seized with a shivering, and in fine they became paralytic in their feet only; after which they died, turning their head very quick to the right and left, with their mouth wide open. During this scene, he perceived a spasmodic contraction in all the muscular parts of the neck.

July the 15th, he pricked a hawk in the left claw: into the puncture he introduced a small drop of the poison of ticunas mixed with that of lamas, and then set the creature at liberty. From that moment it was impossible for him to fly; the most he could do was to perch on a stick, which was within six inches of the ground. There he shook his head several times, as if to get rid of something that seemed troublesome in his throat. His eyes were restless, and his feathers were all bristled up. In fine, after several gapings, his head fell all at once between his legs, and in three minutes he died thus, with his wings expanded. He repeated this experiment on several sorts of birds *, and they all died with pretty much the same symptoms as those above-mentioned, and in as short a time. He made six of these birds swallow a good dose of sugar, before inoculating them with the poison: three of them escaped death, but the other three died very soon. The moment after inserting the poison into four other birds, he made them swallow a good deal of sugar; but that did not prevent their dying, almost as soon as those that had taken none. He made other birds swallow sea-salt instead of sugar; and not one of them recovered, whether they took it before or after the application of the poison.

July the 16th, he put a little of the same poison into a small wound he had made in the right fore foot of a young rabbit. The moment this operation was performed, he cut off that foot above the place of insertion of the poison. He dressed the stump, and the animal did not die. Some days afterwards, he repeated this

* As pigeons, hens, blackbirds, sparrows, ducks, geese, and magpies.—Orig.

experiment on two large dogs, and on a lamb; and not one of them died.

July the 20th, he made a tight ligature on the right hinder leg of a young rabbit, in order to see, if he could thereby prevent the poison from penetrating too quick into the mass of blood. That done, he put a drop of the poison of ticunas and lamas into a small wound, which he made below the ligature: and the animal died in less than two minutes.

July the 22d, he poisoned the point of a sword with the same poison; and with this sword he pierced the left thigh of a large cat, which died in a minute, without shewing any signs of suffering.

July the 24th, after having introduced some of the same poison into little wounds, made in the legs, and other parts, of several dogs, cats, foxes, and horses, he immediately applied a red hot iron, or burning charcoal, on the wounds: not one of these animals died: but this operation must be performed very speedily.

July the 30th, he pricked a great number of rats and mice in the feet, with a lancet, after poisoning its point. They all died in less than a minute, after being tormented with a frightful shivering, which was immediately followed by an almost general palsy. The same thing happened to moles, which he made use of for this experiment.

August the 6th, he made a small wound in the left hinder leg of a pig, of three months old; and then he put into it two drops of the poison of ticunas; this creature died in six minutes. He repeated this experiment on two young wolves, which died in the same space of time.

August the 7th, he cut off the tip of the ear of six puppies, and rubbed the part with the poison of ticunas; not one of these animals died of this operation. Two days after, he shaved the hair off of their backs very close, and rubbed the part with the same poison; they all died in less than three minutes.

The 10th, 11th, and 12th of the same month, into small wounds made in different parts of the body of several dogs, cats, polecats, Guinea-pigs, &c. he instilled seven or eight drops of blood, which he drew from the vena cava of a dog, which he had killed with the poison of ticunas mixed with that of lamas. These animals did not

die indeed, but were plainly indisposed; insomuch that they lost their vivacity, and became very sullen. Eight days after this experiment, he repeated it on these same animals; and then they became still weaker and fainter. In fine, the next he made it a third time on them, when they languished four or five days, and then died.

August the 15th, after having put some of the same poison into a wound made in the right hinder leg of six horses, one of which was a very vigorous stone-horse, he quickly bled them all in the neck to fainting: two of them escaped with life; but those that were the weakest, and most worn out could not stand against this operation. Two days afterwards, he again pricked those horses that did not die of the last experiment; and then they died in about eight minutes.

He made the following observations on these animals, from the insertion of the poison to their death. The muscle, wounded by the incision made for insinuating the poison, was contracted and relaxed alternatively, just as it happens in animals fresh killed: this lasted about two minutes; after which these animals seemed restless and impatient, endeavouring to scrape the ground with their fore foot, which he had suspended in the air with a cord, to prevent their running away. Sometimes also they made a sudden effort, as if to get away, which lasted the space of two minutes; after which they grew quiet, and amused themselves with nipping the grass, but not in a natural manner. Then their respiration became very difficult; and, though the weather was very hot, there visibly came out of their nostrils a vapour, like that which issues in winter in the time of expiration. A minute after, he observed that these horses endeavoured to rest the suspended leg on something: and, in another minute, he perceived the fore leg, that rested on the ground, beginning to grow weak, and bend; which occasioned these animals to fall forward, and rise up again alternately, with more or less difficulty. In two minutes more, their hind legs grew weak, and bent under them, like the fore legs; and in fine, these animals fell down like a dead lump, without being able to rise again, though he whipped them severely. Then their sides began to work, and the whole habit of the body was seized with a dreadful horror. He whipped them, and pricked them with a pin; but in vain; for they gave no sign of feeling. All the muscles of

the trunk and extremities were become paralytic; and none retained their action, but those of respiration, and those of the ears and eyes. These creatures continued in this condition about two minutes; after which their respiration became so operose, that each inspiration consisted of three successive attempts, and then followed a most precipitate expiration, accompanied with so violent a hiccup, that the body bending double, the hind legs were pulled quite to the fore legs. In fine, this manner of taking in and letting out breath lasted one minute; in which time their eyes were darkened, and death ensued.

He opened the dead bodies of these horses, and observed as follows: the blood was of a deep-brown colour, and spouted out in a full stream, which lasted near a minute, both from the arteries and veins, which he cut. This phenomenon surprized him much, as well as the horse-flayer, who attended him, and assured him that he had never seen the like. The muscles were flaccid, blackish, and very cold. The heart was so violently contracted, that, in cutting it across, he could not see any appearance of the ventricles, till he pulled their sides asunder by force. The ungs and liver were stuffed with blood.

In making the small wounds, for introducing the poison, great care must be taken, to avoid cutting any trunk of an artery or vein; because, when that happens, the blood that issues out, carries off a good part of the poison; which makes the animal pine more or less without dying; or, if he dies, it is in a longer or shorter time, according to the quantity of the poison that has got into the vessels, and been mixed with the circulating fluid. This thing happened to him in trying the experiment on a mare, which had been condemned to the laystall. This beast lived about four hours, because the wound bled abundantly, and hindered the success of the experiment, for the reasons alleged above.

November 18, he took a small steel arrow, and poisoned it with the poison of ticunas mixed with that of lamas. He caused this arrow to be shot into the right hinder leg of a bear, belonging to M. de Reaumur, which he wanted to have killed, in order to put it into his cabinet of natural history. The creature immediately roared out, from the anguish of the puncture; after which he made a tour round the stable, in which he was, without seeming to be in

any pain. Soon afterwards he fell on his side, and died in less than five minutes, having his throat squeezed, as if he had been strangled.

M. le Chevalier de Grossée had an eagle, which he had kept a good while in his court-yard, and intended to make a present of it to M. de Reaumur, to adorn his cabinet, but wanted to know how to put it to death without damaging the feathers. M. de Reaumur sent him the same arrow above-described, which had been fresh dipped in the poison; it was struck into the wing of this large bird, which dropped down dead in an instant.

Such are the chief experiments, which M. H. made with the poison of ticunas and lamas: and the following are the results of his observations. 1. In almost all the animals, which he killed with the poison of ticunas and lamas, he observed, that in general they seemed to feel little or no pain before dying, by the action of this poison. 2. That before they die, these animals are seized with a sudden and almost universal palsy. 3. Though the colour of the blood seemed to be altered in certain animals, yet we ought not to draw any inference from thence; because in many others the blood had undergone no sort of alteration, either in colour or consistence. 4. That all the muscles are so vastly contracted in the animals thus poisoned, that there is not a drop of blood to be found in them, whatever way you cut into them. These muscles are clammy to the touch, and seem to approach the condition of flesh beginning to be tainted, which feels clammy. 5. That he did not know a more certain rule for determining that an animal died by the energy of this poison, than this state of the flesh which feels clammy immediately after death; but a person must have handled it more than once, if he would avoid being mistaken. 6. That the whole mass of blood, during the action of the poison, is carried in abundance into the liver and lungs. 7. That neither sugar nor sea-salt ought to be regarded as a specific antidote; because the poison operates so quick, that it does not allow time for these drugs to act, so as to prevent death. He had found nothing but red-hot iron applied in time, that cures with sufficient certainty. 8. That the more the animal is of a lively and sanguine constitution, the more speedily and forcibly the poison acts. 9. The lustier and fatter the animal is, the more poison, and time also, are required for producing the expected effects.

He remarks, that the poison must be dried on the instrument, before it be struck into the animal, which we intend to kill: for if it be liquid, it remains on the outside of the wound, while the instrument penetrates into the flesh: in which case, either the animal dies not all, or at least with great difficulty: as it happened with regard to a wolf, which did not die, though the arrow above-mentioned was struck into one of his thighs; because the poison, which it retained from the dip, continued liquid, and remained on the outside of the wound made by the arrow in piercing the flesh. Therefore time must be allowed for the poison to become hard on the instrument, which is intended to be used; that so, entering into the wound together with the weapon, it may be there diluted, and carried in the course of the circulation to those parts which it must effect, in order to cause death.

M. Fontana's observations on the same poisons in a dried state, seem to prove that the fume of the material whether inhaled or smelled into, is very innocent. That it was perfectly soluble in water, even cold, and in mineral acids as well as vegetable. That it did not effervesce with alkalies, nor acids, nor caused any change in milk. That it neither turned the acid of radishes red nor green. That this poison had no more effect when applied to the eye, than if it were bathed in water. That if taken internally it proves deleterious, but that a considerable quantity is required to kill even a small animal. By passing threads impregnated with the poison, and then dried, through the skins of rabbits and Guinea pigs, and other animals, they died in a short time. If applied to the skin lightly scratched in birds and quadrupeds, it proves for the most part mortal, although not always.

A hundredth part of a grain will kill a small animal; but the poison must be dissolved, either to occasion death, or any disorder of the animal economy. Where there are fewer blood vessels, the poison is the least efficacious. If the poison be applied, being previously dissolved in the mineral acids, its effects seem to be destroyed. Rum and vinegar seem not to extinguish its effects; and even the acids seem useless and dangerous, when applied to the muscles of an animal. It requires a more considerable time to act than the venom of the viper. The effects of both poisons may be remedied by a ligature round the limb, or by amputation, if done in time.

Engraved by Scott, from a Drawing by Craig. For the Gallery of Nature & Art.

THE UPAS, OR POISON TREE OF JAVA.

Mr. Fontana likewise observes, that this poison does not act on animals of cold blood. This poison hinders likewise the coagulation of the blood from those killed by it; but if introduced into the blood by the jugular vein, it produces death; and that it does not act on the nerves, but only on the blood.

[*Phil. Trans. Pantolog.*

SECTION IX.

Bohan, or Bohan-upas.

JAVA appears to be possessed of various trees, the juices of which are fatally poisonous. These vegetable poisons, in the language of the country are called *upases*. In the first section of the present chapter we have noticed the destructive power of two of these *upases*—the *upas tienté* and the *upas antiar*. The tree named *bohan*, concerning which we have hitherto received no systematic description, produces a upas, or vegetable poison, of a still more active nature. Its effects indeed have been very unnecessarily exaggerated by many writers, but they are truly marvellous in the plain unvarnished fact.

The best and most satisfactory description we have hitherto received of the bohan tree, and its extraordinary and fatal secretion, has been communicated by M. Delille, a translation of whose paper in English was read in June, 1810, before the fellows of the Royal Society. M. Delille is a French physician, a member of the National Institute of Egypt, and transmitted this paper from the East Indies to the Royal Society, by means of an English lady. The botanical account of this poisonous plant he received from one of the French naturalists who accompanied Capt. Baudin, and who resided some time in Java; where he visited the interior of the country, and with much difficulty succeeded in prevailing on the natives to show him the different poison-plants, which they carefully conceal in order to use them during war. Hence the reason of so many fables as have been repeated respecting the extraordinary destructiveness and influence of the upas, which in the language of the Javanese signifies vegetable poison, and is applied only to the juice of the bohan tree, and another twisted-stemmed plant.

The bohan is a large tree, which this writer considers a new genus: the other plant, yielding an equally powerful poison, is of the wood bine genus. The upas, or poisonous juice, is extracted by an incision in the bark with a knife, and carefully collected and preserved by the natives to be used in their wars. As to its diffusing noxious effluvia in the atmosphere, and destroying all vegetation around it, the absurdity of these stories is best exposed by the fact, that the climbing species requires the support of other plants to attain its usual growth. Dr. Delille made several experiments with the upas on dogs and cats. An incision was made in the thigh of a dog, and eight grains of upas dropped into it: shortly after the dog began to vomit, and continued vomiting at intervals, till he became convulsed, the muscles of his head greatly distorted, and he died in twenty minutes. Six grains were put into the thigh of another dog, which also vomited first his undigested food, next a white foam, and died, contracted and convulsed, in fifteen minutes. A cat was also treated in like manner; but she was still sooner and more convulsed, and her muscles contracted: she continued leaping up for a few minutes, and fell down dead. All these animals died crying and in great agony. After repeating a number of experiments on the deleterious and prompt effects of this powerful poison, when applied externally, the author gave a grain and a half to a dog, which he took into his stomach, but it only produced a slight purging. To another four grains were given, which in about four hours produced both vomiting and purging, and the dog died in the course of half a day. On examining the bodies of these animals after death, no very extraordinary appearances were discovered; the ventricles of the heart were full of blood, and some slight traces of inflammation appeared in the stomach; but the derangement was not so great as might have been expected from such a violent and sudden death. From this circumstance, the author concluded that the absorbents had transmitted the poison to the nerves of the stomach, and that this peculiar vegetable poison acts exclusively on the nerves.

Messrs. Majendie and Delille have communicated to the class their experiments made on animals by means of the matter with which the natives of the Isles of Java and of Borneo poison their arrows.

M. Vauquelin has also made some experiments of this kind: at the end of his chemical analysis of the juice of the belladonna, he speaks of the effects of this substance on animals. Those which he forced to swallow it, fell down as if intoxicated, in a delirium precisely similar to that produced by opium.

M. Sage has reported on the same subject some more experiments, which chance threw in his way, or which he collected from others, and which confirm the action of this juice on the nervous system, and particularly on the brain.

A young practitioner in medicine, whose name has been mentioned in former annual reports, M. Nysten, has attempted to ascertain the effects of different gases injected into the blood-vessels of animals: he used the greater part of the gases with which we are acquainted. Atmospheric air, oxygen gas, the oxidulated azotic, carbonic acid, carbonic, phosphuretted and hydrogenated gases, &c. are in no respect deleterious. The oxy-muriatic, nitrous acid, and ammoniacal gases, seem to act by very violently irritating the right auricle and the pulmonary ventricle. The sulphuretted hydrogen, oxide of azote, and azotic gases, injure the contractile power of these parts: others also change the nature of the blood so completely, that respiration can no longer convert it from venous blood into arterial, &c.

[*Mem. de St. Instit. Nat.* 1809.

CHAP. VI.

PLANTS CURIOUS OR USEFUL IN THE ARTS.

SECTION I.

Kadsi, or Paper-tree of Japan.

Morus Papyrifera.—LINN.

THE Morus or Mulberry genus contains seven species, mostly natives of hot climates. Of these two are of great use in the arts: Morus tinctoria, or fustic-wood, a fine American timber tree affording a principal ingredient in most of our yellow dyes, for which purpose this material is an extensive object of commerce; and morus papyrifera, or kadsi of Japan, from which the ingenious natives manufacture their beautiful and glossy paper. This tree is also found in Otaheite and others of the Australasian or South Sea Islands, where the bark is spun into the finest sort of cloth. It has of late years been propagated from seeds in France, and in a sandy soil, is said to thrive better than the common mulberry. Like the last, its leaves are also an excellent food for the silk-worms.

The following is the process pursued in Japan for converting the bark of the kadsi into paper. Every year, when the leaves of the paper-tree fall off, the young shoots are cut into sticks about three feet long, and being tied up in bundles are boiled with water till the bark shrinks from the wood. The sticks are then exposed to the air till they grow cold, and being slit open length-ways, the bark is taken off, dried, and carefully preserved. Afterward, being soaked in water till it is soft, it is scraped, and the stronger bark, which is a full year's growth, is separated from the thinner, which covered the younger branches, the former yielding the best and whitest paper. The bark being then cleansed from all knots and impurities, is boiled in clear lye, and constantly stirred about till it becomes so tender, that on being slightly touched, it will separate into small fibres. The bark thus softened is washed in a river in sieves, and constantly stirred about with the hands, till it is diluted into a soft delicate wooly substance, and then put upon a thick, smooth, wooden table,

to be beat with sticks till it resembles the pulp of soaked paper. The bark thus prepared is put into a narrow tub, with the slimy infusion of rice, and the infusion of the *oreni* root, which is also slimy and mucous; which being mixed into an uniform liquid substance, by stirring it with a thin reed, the sheets are formed one by one, by taking up this liquid substance in a proper mould made of bulrushes instead of wire, carefully laid one upon another, on a table covered with a double mat, while a small piece of reed is put between every sheet; which standing out a little, serves in time to lift them up conveniently, and take them off singly. Every heap is covered with a small board of the same shape and size with the paper, on which are laid weights, which are at first small ones, lest the sheets, which are as yet wet and tender, should be pressed together into one lump; but by degrees are added more and heavier, to squeeze out the water. The next day the weights are taken off, and the sheets lifted up one by one, and with the palm of the hand clapt to long planks, and exposed to the sun: when fully dry, they are taken off, laid up in heaps, pared round, and then kept for use or sale.

[*Seba. Kæmpfer. Amœnitates.*

SECTION II.

Cotton-plant.

Gossipium.

THIS genus produces ten species of trees, shrubs, or herbaceous plants; a few of them natives of America, but by far the greater number of Asia.

Most of these afford a wool that may be usefully applied to mechanical or domestic purposes, or woven into cloths. The cotton shrubs of the American islands grow without the smallest cultivation, but their wool is coarse and short, and hence cannot easily be spun; if imported into Europe it might answer the purpose of felts in the manufacture of hats; but it is generally consumed by the inhabitants themselves, as stuffing for pillows and mattresses.

The generality of the West India species are annuals; but G. arboreum of India is a perennial tree, both in root and branch, rising in a straight line about eight feet high, with leaves in five palmate lobes: the lobes lanceolate, obtuse, and mucronate.

The cotton chiefly selected for propagation is G. herbaceum, a

native of the East Indies; a pubescent herb; with the stem spotted with black at its top; leaves downy, penduncles branched, shorter than the petioles; outer calyx three-parted, with heart-shape, cut segments dotted with black; corol one-pefalled, with a short tube, five-parted, the segments pale yellow, with five red spots at bottom; capsule three-valved, three-celled. The pods are not unfrequently as large as middling-sized apples. The common cotton plant thrives best in respect of pod in new grounds; but best in respect of fruit in dry stony ground that has been tilled already; and hence such is the soil generally preferred by our planters. The period of cultivation commences in March and April, and continues during the spring rains. The holes for the seeds are made in distinct rows, something like hop-planting, at a distance of seven or eight feet from each other; the seeds are thrown in and earthed over; and when they have shot forth to the height of five or six inches, all the stems are pulled up, excepting two or three of the strongest. These are cropped twice before the end of August, nor do they bear fruit till after the second pruning. By such repeated croppings, the plant, though naturally an annual, may be prolonged and made to bear sufficiency of fruit to repay the planter for three years, yet it is better to renew them, if there be opportunity. When the cotton is gathered in, the seeds are picked out from the wool, by means of a cotton-mill, of a simple contrivance, and perfectly adequate to the purpose.

The cotton shrub of China is rendered essentially useful in that country. When the husbandman has got in his harvest, then he sows cotton in the same fields; and raking the earth over the seeds, a shrub about two feet high is produced, the flowers of which appear by the middle of August. These are generally yellow, but sometimes red. The flower is succeeded by a small button of the size of a nut, which opens in three places; and on the fortieth day after the appearance of the flower, discovers three or four wrappings of cotton extremely white, and of the same form as the cod of the silk-worm; this being fastened to the bottom pod, contains seed for the following year. It is then the season for getting in the crop; but in fair weather they leave it to be exposed two or three days to the heat of the sun, which causing it to swell, increases its value. As all the fibres of the cotton are strongly fastened to the seeds they inclose, the people make use of an engine to separate them. It

contains two smooth rollers, one of wood and the other of iron, about a foot long and an inch thick, in a manner close to each other. While one hand gives motion to the first of these rollers, and the foot to the second, the other hand applies the cotton, which is drawn through and separated from the seeds which remain behind. Afterward they card and spin the cotton, and weaving it, convert it into calico.

On the island of Sumatra the silk cotton tree flourishes near the city of Acheen. These trees are large, and have a smooth ash-coloured rind, and are generally full of fruit, which hangs down at the ends of the twigs like purses, three or four inches long. No tree can grow more regular and uniform; the lower branches being always the largest and longest, and the upper gradually lessening to the top. When the cotton is ripe, the cods drop off the tree, for the cotton is so short, that it is not thought worth gathering; though they will sometimes take the pains to pick it off the ground, to stuff their quilts with.

The cotton shrub of Hindostan is of great use, for of this they manufacture ginghams, muslins, calicoes, &c. and therefore, every year, sow large fields with the seed.

The cotton tree is also cultivated there, and grows to a great height. The fruit, if it may be so called, or pod, becomes of the size of a hen's egg; and then bursting, like that of the shrub, yields a fine white wool.

In Abyssinia, the cotton shrub is extremely plentiful.

[*Linn. Lockyer. Burrow. Lettres Edifiantes et Curieuses.*

SECTION III.

New Zealand Flax.

Phormium tenax.—Wilden.

The systematic name for the common flax is *linum*, of which there are twenty-five known species; the *linum usitatissimum*, or peculiarly useful *linum*, being that employed in our manufactories of linen: several of the other species, however, being useful to a certain extent for other purposes. The flax before us is of a different genus, and is called *phormium*; it possesses but one species, that described above by the name of *tenax*. It is exquisitely silky, grows luxuriantly in New Zealand, and will, as we trust,

before long be transplanted to New South Wales, and be found growing with equal luxuriancy in that territory. In the former country it flourishes every where near the sea, and in some places a considerable way up the hills, in bunches or tufts, with sedge-like leaves, bearing on a long stalk yellowish flowers, which are succeeded by a long roundish pod, filled with very thin shining black seeds.

This plant serves the inhabitants instead of flax and hemp, and excels all that are put to the same purposes in other countries. Even of this plant there are two sorts, and the leaves of both resemble those of flax, but the flowers are smaller, and their clusters more numerous; in one kind they are of a deep red, and in the other yellow. Of the leaves of these plants, with very little preparation, they make all their common apparel; and of these they also make their strings, lines, and cordage, for every purpose; which are so much stronger than any thing we can make with hemp, as not to bear a comparison. By another preparation they draw from the same plant long slender fibres, which shine like silk, and are as white as snow: of these, which are also surprisingly strong, the finer cloths are made; and of the leaves, without any other preparation than splitting them into proper breadths, and tying the strips together, they make their fishing nets, some of which are of an enormous size. This plant, which is found in hill and valley, in the driest mould and in the deepest bogs (but that in the bogs is the largest), would be a great acquisition to England, could it be brought to flourish here. With this view Captain Furneaux brought over a quantity of the seed: and after quitting New Zealand, he touched at no other land than the Cape of Good Hope, until he arrived at Spithead, having traversed one entire hemisphere of the globe in seven months. These seeds were immediately carried to his Majesty, and by his order sown in Kew garden; but the whole unfortunately failed, and there with the hope of acquiring this valuable vegetable.

[*Cook. Miller. Editor.*

SECTION IV.

Indigo.

Indigofera tinctoria.—LINN.

THE indigofera genus is extensive, embracing not less than fifty-one known species, chiefly natives of India and of the Cape. The most important of the whole is that now before us, the common indigo plant, specifically denominated by Linnéus from its useful dye, *indigofera tinctoria.* This plant is now chiefly cultivated in North and South Carolina, and the neighbouring state of Georgia; the dye obtained from it bears the name of the plant which produces it; which was probably so called from India, where it was first cultivated, and from which country, for a considerable time, the whole of what was consumed in Europe was brought. This plant, when grown, resembles the fern, and when young is scarcely distinguishable from lucern grass. Indigo is generally planted after the first rains which succeed the vernal equinox: the seed is put into the ground in small straight trenches, about eighteen or twenty inches asunder, and is fit for cutting the beginning of July. It cuts again toward the end of August, and if a mild autumn succeeds, there is a third cutting at Michaelmas. The indigo land must be weeded every day, and the plants cleansed from worms. Each acre yields sixty or seventy pounds weight of indigo, which at a medium is worth fifty pounds.

The indigo when cut is first laid in a vat about twelve or fourteen feet long, and four deep, to the height of about fourteen inches, to macerate and digest. Then this vessel, which is called the steeper, is filled with water: the whole having lain about twelve or sixteen hours, according to the weather, begins to ferment, swell, rise, and grow insensibly warm; at this time spars of wood are run across to prevent its rising too much, and a pin is then set to mark the highest point of its ascent: when it falls below this mark, they judge that the fermentation has attained its due pitch, and begins to abate; upon which the manager turns a cock, and lets off the water into another vat, which is called the beater; and the gross matter that remains in the first vat is carried off to manure the ground.

When the water, strongly impregnated with the particles of in-

digo, has run into the second vat, they agitate it till it heats, froths, ferments, and rises above the rim of the vessel in which it is contained: to allay this violent fermentation, oil is thrown in as the froth rises, which causes it instantly to subside. After this beating has been continued from twenty to thirty minutes, a small muddy grain begins to be formed; and when this is completed lime water is added from an adjacent vessel; when the indigo granulates more fully, the liquor assumes a purple colour, and after being well stirred together with the lime water is allowed to settle. The clear water is then permitted to run off into a succession of vessels, so that every portion of the indigo carried away may have an opportunity of settling and being preserved; when the thick purple sand, which forms the residuum, is put into bags of coarse linen. These are suspended till the moisture is drained off, after which the clotted material is turned out of the bags and worked upon boards of a porous timber with a wooden spatula. It is, at the same time, frequently exposed to the morning and evening sun, but only for a short period at a time, and is then put into boxes or frames, where it is again exposed to the sun in the same cautious manner; till with great labour and attention the operation is finished, and that valuable drug called indigo fitted for the market. The greatest skill and care is required in every part of the process, without which there is great danger of spoiling the whole.

In the American states much attention has been paid to encourage the cultivation of indigo; for which purpose, the uniform of the national troops is blue, as also that of the militia in general: the clergy are also allowed, by the established custom of the country, to wear that colour; and it is generally adopted, both by the most frugal and most expensive people: all which circumstances operate favourably for the indigo planters, without any expence to the country.

In Hindustan the indigo-shrub grows to the height of a gooseberry bush, and has a thick round head, but no thorns. The people strip off the leaves, and having laid them in a heap, they lie several days, till they have sweated, and are then put into deep vessels, with a sufficient quantity of water, to which they give their blue tincture. The water is afterward drained into broad shallow vessels, made of a kind of plaster of Paris, where the sun having exhaled all the moisture, there remains at bottom a hard dry cake,

about a quarter of an inch thick, which is our indigo. The best sort is brought from Biana, near Agra, and a coarser kind is made near Amadabad.

In the kingdom of Morocco, the province of Tafilet produces indigo which grows without art or culture, and yields a more vivid and lasting blue than that produced in the West Indies.

[*Linn. Cox. Barton.*

SECTION V.

Logwood.

Hæmatoxylum campechianum.—Linn.

The campechianum is the only species of the hæmatoxylum hitherto discovered; it is a much smaller tree than the guaiacum, and both the trunk and the branches are extremely crooked, and covered with dark-coloured rough bark; the smaller ramifications are numerous, close, prickly, or beset with strong sharp spines; the leaves are pinnated, generally composed of four or five pair of pinnæ, of an irregular oval shape, obliquely nerved, and obtusely sinuated at the top; the flowers grow in racemi, or in close regular terminal spikes, and appear in March; the calyx divides into five oblong obtuse segments, of a brownish purple colour; the petals are five, patent, obtusely lance-shaped, and of a reddish yellow colour; the stamina are somewhat hairy, tapering, of unequal length, shorter than the corolla, and the antheræ are small and oval; the style is nearly the length of the stamina, and the germen becomes a long double valved pod, which contains many oblong compressed, or somewhat kidney-shaped, seeds.

This tree is a native of South America, and grows to the highest perfection at Campeachy, in the Bay of Honduras, whence the seeds were brought to Jamaica, in 1715, with a view of propagating it as an article of commercial export. And though it does not appear to have answered this purpose so fully as could have been wished, yet we are told that in some parts of the island, especially where the ground is swampy, this tree, in the course of three years, will rise to the height of ten feet, and by this quick and luxuriant growth, soon overrun and destroy the neighbouring plants *. The

* In some parts of Jamaica, are such quantities of it, growing wild, as to incommode the land-holders extremely." Long's l. c. 754. He also observes, that "it makes an excellent and beautiful fence, which, if kept properly trimmed, grows so strong and thick, that nothing can break through."

logwood tree was first cultivated in Britain by Mr. P. Miller, in 1739 *, who says, "there are some of these plants now in England which are upwards of six feet high, and as thriving as those in their native soil †; but this observation will not apply to the present time, for we have searched in vain for this plant through most of the principal garden stoves in the neighbourhood of London.

The wood of this tree is of a solid texture, and of a dark red colour; it is imported into Europe principally as a dying drug, cut into junks or logs of about three feet in length; of these pieces, the largest and thickest are preferred, as being of the deepest colour. This wood has a sweetish subastringent taste, and no remarkable smell; it gives a purplish red tincture both to watery and spirituous infusions; but is chiefly used, and in great quantities, for dyeing purple, and especially black colours. All the colours, however, which can be prepared from it, are of a fading nature; and cannot by any art be made equally durable with those prepared from some other materials. Black, though not altogether a fixed colour, is the most durable of the whole. Dr. Lewis recommends it as an ingredient in making ink. "In dyeing cloth," says he, "vitriol and galls, in whatever proportions they are used, produce only browns of different shades: I have often been surprised that with these capital materials of the black dye, I never could obtain any true blackness in white cloth, and attributed the failure to some unheeded mismanagement in the process, till I found it to be a known fact among the dyers. Logwood is the material which adds blackness to the vitriol and gall brown; and this black dye, though not of the most durable kind, is the most common. On blue cloth a good black may be dyed by vitriol and galls alone; but even here an addition of logwood contributes not a little to improve the colour." Mr. Delaval, however, in his Essay on Colours, informs us, that with an infusion of galls and iron filings, he not only made an exceeding black and durable ink, but also dyed linen cloth of a very deep black.

[*Lewis. Woodville. Wildenow.*

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* Hort. Kew.

† Dictionary abridged, sixth edition.

SECTION VI.

Madder.

Rubia tinctorum.—LINN.

THIS is a native of the south of France, and flowers in July. The root is perennial, long, round, jointed, beset with small fibres; externally of a bright red, but towards the center yellowish. The branches stand in pairs at the articulations of the stalks, and upon their various subdivisions produce small terminal flowers of a yellowish colour.

Madder is frequently mentioned by the Greek writers, who employed its roots with the same medicinal intentions for which they now are recommended by most of the modern writers on the Materia Medica. Our knowledge of the first cultivation of this plant in England is from Gerard *; and though an extensive cultivation of Madder in Britain seems to promise considerable advantage, both to the planter and to the nation, yet we find that the great quantity of madder roots used here by the dyers and calico-printers, has been for many years almost wholly the growth and export of Holland †. Madder appears to differ from other substances used for the purpose of dying, in having the peculiar property ‡ of tinging with a florid red colour not only the milk, urine, &c.§ but even the bones of those animals which have fed upon it; a circumstance which was first noticed by Antonius Mizaldus ||, but not known in England till Mr. Belchier published an account of a pig and a cock,

* Vide Hort. Kew.

† Miller Dict. in which is also given a full account of the cultivation of this plant. But we are happy to observe, that by the laudable endeavours of the Society for the Encouragement of Arts, &c. considerable quantities of English madder have been produced, and found as good at least, if not better than any imported. See Transactions, p. 10. vol. i.

‡ Some other plants of the same natural order (stellatæ) have also the effect of tinging the bones, as the gallium mollugo and aparine. Vide Guettard Mem. de l'Ac. de Sc. a. 1746 & 1747. And the valantia cruciata. Böhmer Diss. de rad. rub. tinct. p. 42.

§ Bönmer also found the serum of the blood reddened by the madder. Diss. rad. rub. tinct. &c. p. 13. And Levret observes, that it sometimes tinged the excretion by the skin. Sur les Accouchemens, p. 278.

|| Memorab. ut. ac jacunda Cent. 7. Aph. 91. Lutet. 1566.

whose bones became red by eating madder mixed with their food *; since that time various experiments relating to this subject have been made, from which it appears that the colouring matter of madder affects the bones in a very short time; and that the most solid, or hardest, part of the bones first receives the red colour, which gradually extends, *eb externo*, through the whole osseous substance, while the animal continues to take the madder; and if this root be alternately intermitted and employed for a sufficient length of time, and at proper intervals, the bones are found to be coloured in a correspondent number of concentric circles. According to Lewis, " the roots of madder have a bitterish somewhat austere taste, and a slight smell not of the agreeable kind. They impart to water a dark red tincture; to rectified spirit, and to distilled oils, a bright red; both the watery and spirituous tinctures taste strongly of the madder †."

[*Hort. Kewens. Millar. Lewis.*

SECTION VII.

Copal ‡.

Elæocarpus copalliferus.—LINN.

THE elæocarpus genus comprises five species, of which all are trees, chiefly indigenous to India or Australasia: the copal-tree, copalliferous, constitutes one of these, and which is also found in Africa and America.

The resinous substance, called gum copal, and which is supposed to be a secretion from this tree, is imported from Guinea, where it is found in the sand on the shore. It is of a yellow colour, faintly glistening, imperfectly transparent, and apt to break with a conchoidal fracture. It is tasteless, and, when cold, inodorous. It is used dissolved in rectified spirits of wine, or other volatile solvents, both as a varnish, and as an astringent medicine. In North America, the natives obtain a very considerable quantity of this resin

* Phil. Trans. vol. xxxix. p. 287. & p. 299. See also vol. xli. Afterwards experiments were prosecuted by Bazanus, Geoffroy, Du Hamel, Fougeroux, Bergius, and others.

† Mat. Med. p. 546.

‡ For gum lac and cochineal, see the next book.

from the rhus copallinum, but it is of an inferior quality to that brought from Guinea and Spanish America.

The specific gravity of copal varies from 1·045 to 1·139. Mr. Hatchett found it soluble in alkalies and nitric acid, with the usual phænomena.

Copal varnish used by the English japanners is made as follows. Four parts by weight of copal in powder are put into a glass matrass and melted. The liquid is kept boiling till the fumes condensed upon the point of a tube, thrust into the matrass, drop to the bottom of the liquid without occasioning any hissing noise, as water does. This is a proof that all the water is dissipated, and the copal has been long enough melted. One part of boiling hot linseed oil (previously boiled in a retort without any litharge) is now poured into it, and well mixed. The matrass, if then taken off the fire, and the liquid, while still hot, is mixed with about its own weight of oil of turpentine. The varnish thus made is transparent, but it has a tint of yellow, which the japanners endeavour to conceal by giving the white ground on which they apply it a shade of blue. It is with this varnish that the dial plates of clocks are covered, after having been painted white.

A correspondent in the 17th volume of the Transactions for the Encouragement of Arts, &c. informs us, that copal may be dissolved in spirit of turpentine by the following process: having prepared a glass vessel, of sufficient capacity to contain at least four times the quantity intended to be dissolved, and which should be high in proportion to its breadth, reduce two ounces of copal to small pieces, and put them into the vessel. Mix a pint of spirit of turpentine with one-eighth of spirit of sal ammoniac; shake them well together; pour them on the powder, cork the glass, and tie it over with a string or wire, making a small hole through the cork. Set the glass in a sand heat, so regulated as to make the contents boil as quickly as possible; but so gently, that the bubbles may be counted as they ascend from the bottom. The same heat must be kept up exactly, till the solution is complete. It requires the most accurate attention to succeed in this operation; for, if the heat abate, or the spirits boil quicker than is directed, the solution will be impeded, and it will afterwards be in vain to proceed with the same materials; but, if properly managed, the spirit of sal ammoniac will be seen gradually to descend from the mixture, and at-

tack the copal, which swells and dissolves, except a very small quantity. It is of much consequence that the vessel should not be opened till some time after the liquid has become perfectly cool; as it frequently happens that the whole of the contents are blown with violence against the ceiling. The spirit of turpentine should be of the best quality.

Mr. Sheldrake has lately favoured the public with another and easier method of dissolving copal. This method is as follows: Provide a strong vessel made of tin or other metal; it should be shaped like a wine bottle, and capable of holding two quarts; it will be convenient to have a handle strongly rivetted to the neck; the neck should be long, and have a cork fitted to the mouth, but a notch or small hole made in the cork; that, when the spirit is expanded by heat, a small portion may force its way through the hole, and thus prevent the vessel from bursting. Dissolve half an ounce of camphor in a quart of spirit of turpentine, and put it into the vessel; take a piece of copal the size of a large walnut, reduce it to a coarse powder or very small pieces; put them into the tin bottle, fasten the cork down with a wire, and set it, as quick as possible, upon a fire so brisk as to make the spirit boil almost immediately; then keep it boiling very gently for about an hour, when so much of the copal will be dissolved as will make a very good varnish; or, if the operation has been properly begun, but enough of copal has not been dissolved, it may be again put on the fire, and by boiling it slowly for a longer time, it may be at last brought to the consistence desired.

[*Phil. Trans. Trans. Arts. Commerce, &c. Pantol.*

SECTION VIII.

Gum Arabic.

Mimosa Nilotica*.—MUTIS.

THE nilotica, or true Egyptian acacia, from which this vegetable article is chiefly obtained, rises to fourteen or sixteen feet in height. The fruit is a long pod, resembling that of the lupin, and contains many flattish brown seeds. It is a native of Arabia and Egypt, and flowers in July. Although the mimosa nilotica grows

* Acacia vera,—WILDEN.

in great abundance over the vast extent of Africa, yet gum arabic is produced chiefly by those trees which are situated near the equatorial regions; and we are told that in Lower Egypt the solar heat is never sufficiently intense for this purpose. The gum exudes in a liquid state from the bark of the tree, in a similar manner to the gum which is often produced upon the cherry-trees, &c. in this country; and by exposure to the air it soon acquires solidity and hardness. In Senegal the gum begins to flow when the tree first opens its flowers; and continues during the rainy season till the month of December, when it is collected for the first time. Another collection of the gum is made in the month of March, from incisions in the bark, which the extreme dryness of the air at that time is said to render necessary. Gum arabic is now usually imported into England from Barbary, in large casks or hogsheads. The common appearance of this gum is well known; and the various figures which it assumes seem to depend upon a variety of accidental circumstances attending its transudation and concretion. Gum arabic of a pale yellowish colour is most esteemed; on the contrary, those pieces which are large, rough, of roundish figure, and of a brownish or reddish hue, are found to be less pure, and are said to be produced from a different species of mimosa; but the Arabian and Egyptian gum is commonly intermixed with pieces of this kind, similar to that which comes from the coast of Africa near the river Senegal.

Gum arabic does not admit of solution by spirit or oil; but in twice its quantity of water it dissolves into a mucilaginous fluid, of the consistence of a thick syrup.

[*Labat. Mutis. Wildenow.*

SECTION IX.

Elastic Gum. *Caoutchouc or Indian Rubber.*

Siphonia Elastica.—LINN.

THE caoutchouc, elastic gum, or Indian rubber, is obtained chiefly from the siphonia, a genus that possesses but one known species, the *elastica*, a tall tree, indigenous to Guiana, and other parts of South America. It is possessed of the most singular properties: no substance is yet known which is endued in so great a degree

with the united powers of flexibility and elasticity; and it is further remarkable, as being capable, notwithstanding its softness, of resisting the action of very active menstrua. Of this extraordinary production very little was known seventy years ago. In 1736, M. de la Condamine, who accompanied the French academicians to South America, to measure a degree of the meridian, sent a paper on the subject of caoutchouc to the French Academy. From his account we learn that the juice oozes out, under the form of a vegetable milk, from incisions made in the tree; and that it is gathered chiefly in the time of rain, because, though it may be collected at all times, it flows then most abundantly. It thickens and hardens gradually on exposure to the air; and as soon as it acquires a solid consistence, it becomes extremely flexible and elastic. The Indians make boots of it, which water cannot penetrate, and which, when smoked, have the appearance of real leather. Bottles are also made of it, to the necks of which are fastened hollow reeds, so that the liquor contained in them may be squirted through the reeds or pipes by pressure: one of these filled with water is always presented to each of the guests at their entertainments, who never fail to make use of it before eating. Flambeaux are likewise made of this substance; they give a beautiful light, and emit no unpleasant smell: a torch an inch and a half in diameter and two feet long will burn twelve hours. A kind of cloth is also prepared from it which the inhabitants of Quito apply to the same purpose as our oilcloth. The form in which it usually comes to us is something resembling bottles; but it will take any other shape that may be desired, by covering moulds of clay with the juice; and, as one layer of it becomes dry, adding others until it is of the proper thickness: it is then held over a strong smoke of vegetables on fire, by which it is hardened into the texture and appearance of leather; and before the finishing, while yet soft, it is capable of receiving any impression on the outside, which it afterwards retains. When the whole is done, the inside mould is picked out.

Of the trees yielding this singular substance, those growing along the banks of the river of the Amazons are described by M. Condamine as attaining a very great height; being at the same time perfectly straight, and having no branches except at the top, which is but small, covering usually no more than a circumference of ten feet. Its leaves bear some resemblance to those of the manioc;

they are green on the upper part, and white beneath. The seeds are three in number, and contained in a pod, resembling those of the palma Christi; and in each of them there is a kernel, which being stripped and boiled in water produces a thick oil or fat, answering the purposes of butter in the cookery of that country. A similar juice was obtained by M. Poivre some years ago, from a tree in the Isle of France; and various milky juices of nearly the same properties have been extracted from other plants, as the cecropia peltata, the ficus Indica, religiosa, &c.

In the fifth volume of the Asiatic Researches, Mr. Howson has given an account of a tree which he discovered in Prince of Wales's island; and from which he obtained caoutchouc, in almost every respect, exactly similar to that which we receive from America. This tree Mr. Howison denominated the elastic gum vine; but Dr. Roxburgh, who procured specimens of it from Sumatra, and whose botanical description of it appears in the volume just referred to, has classed it under the name of urceola elastica. Those who have not an opportunity of consulting the Asiatic Researches, may find these papers in the Philosophical Magazine, vol. vi. Both these gentlemen have examined this East India plant, its juice, and the caoutchouc formed by it: and they concur in ascertaining its analogy to the American production. Mr. Howison observes that the milk runs but slowly from incisions in the bark, it being full employment for one person to collect a quart in two days. A much more expeditious mode, but ruinous to the vine, is cutting it in lengths of about two feet, and placing under both ends vessels to receive the milk. The best is always procured from the oldest vines; and is often obtained in a consistence equal to thick cream, and which will yield two-thirds of its own weight in caoutchouc. The chemical properties of this milk were found strikingly to resemble those of animal milk. A number of other very curious particulars, which our limits will not permit us to insert, are detailed in the interesting communications to which we have already referred.

The chemical properties of caoutchouc, as far as they have been ascertained, are principally as follow. It is softened by heat, and at length melts, swelling up, and emitting an unpleasant odour: on cooling again, it remains adhesive, acquires the consistence of tar, and never recovers its former elasticity. It yields on distillation

carbonic acid gas, hydrogen gas, an empyreumatic oil, and ammonia; the residue is a trifling quantity of coaly matter. It may be dissolved by heat in fat oils, and will combine also with heated wax. Dr. Roxburgh dissolved it in cajeput oil. Exposure to the air does not affect this substance; and it is not soluble in either water, or alcohol: but if it be boiled in water, the extraneous matter near its surface is carried off, and two or more pieces of it may then be joined together by mere pressure. It is completely soluble in ether, if the ether be previously washed in water; and as the caoutchouc remains unaltered on the evaporation of the ether, this solution may be employed to form it into any shape desired, though it is too expensive for common use. A more simple method of forming tubes of it is to split a piece of cane, and between the pieces introduce a slip of whalebone: if the caoutchouc be then cut into slips and twisted closely round the cane, and heat be applied, the whole will unite into one piece or tube, from which the whalebone and the cane may easily be separated. Some wind a thread round the caoutchouc, when twisted round the cane for the purpose of uniting the joinings, and apply the heat of boiling water. Caoutchouc is also soluble in rectified petroleum; which, in like manner with ether, leaves it unaltered on evaporation. It has been thought to be insoluble in alkalies; but Dr. Thomson proved the contrary by accidentally dissolving it in ammonaical gas. Several of the acids act upon it, as the sulphuric and the nitric; but others do not, as the muriatic. The specific gravity of caoutchouc is 0·9335.

The very ingenious Mr. John Gough of Middleshaw, near Kendal, has made some interesting experiments upon caoutchouc, from which it appears that if a thong of this substance be put into warm water till it becomes quite pliant, and then applied to the lips to estimate its temperature; and if it be then removed, stretched forcibly, and brought again to the lips, while extended; a very sensible increase of temperature will be perceived, which, however, will immediately sink on allowing it to return to its former state. It appears also that if the thong be plunged into cold water immediately upon being stretched and held there, it will be found to have lost much of its contractile power, for it will not on letting go one end return to its former dimensions; but if it be placed in warm water, or held some time in the warm hand, it will re-acquire its

elastic properties, thus affording an analogy to the influence of heat in promoting the ductility of metals.

The chief uses to which caoutchouc is applied in this country are, 1st, The rubbing out of black-lead marks, by which it is universally known, and from which its name of Indian rubber is derived. 2d, The formation, by means of turpentine or linseed oil, of a varnish for air-balloons. 3dly, It supplies the surgeon with flexible syringes, catheters, and bougies; and the chemist with flexible tubes to gassometers and other apparatus. And, lastly, Mr. Howison has shewn that cloth of all kinds may be made impenetrable to water by impregnating it with the fresh juice; and that boots, gloves, &c. made of cloth thus prepared, which may be joined without sewing, by only moistening the edges with the juice, are more durable and retain their shape better than those made of pure caoutchouc. If more of this juice could be obtained, there is no doubt that it might be applied to a great variety of valuable and important purposes.

There are, however, various other plants, from which the elastic gum may be obtained in smaller quantities. Dr. Barton mentions several in America; and Mr. Woodcock, of Islington, has found it in some of the esclipias genus, aspecially a vincetoxicum, and a fruticosa*.

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* There is a curious mineral substance called mineral caoutchouc found in the spar mine, near Castleton in Derbyshire, and which bears in many of its properties a resemblance to the vegetable caoutchouc described above. It was thought, says F. St. Fond, an astonishing circumstance, that a substance which distils from exotic trees, which grow in the torrid zone, should be found between strata of argillaceous schist in the bosom of the mountains in the northern part of England. The depth at which this mineral has been found is not less than four hundred and fifty feet below the upper stratum. There appear to be two species of it, the elastic or compressible, and the solid or brittle; and several varieties of each. See Maw's Mineralogy of Derbyshire; and the memoir of Faujas-Saint-Fond, in Phil. Mag. vol. xv. 225.

SECTION X.

Teak-tree.

Tectonia grandis.—Roxb.

This valuable timber-tree, the glory of India, rises very tall, with a vast trunk, and is the only Indian wood which the termes fatule, or white ant*, will not touch.

The teak is the oak of the Eastern world, indigenous in Pegu, Hindostan, Malaga, and most of the oriental countries; and, like the oak in Europe, employed very generally for ship-building, and all inland purposes, when a strong and durable wood is required. From the excellent properties of this timber, and the peculiar soil and climate which it demands, the patriotic Society of Arts, Commerce, and Manufactures have lately expressed their opinion, that it may be successfully cultivated in our West Indian and African settlements, and have consequently recommended a trial to that effect.

The best account of the teak-tree that we have yet met with is the following of Dr. Roxburgh, of Calcutta, whose botanical activity is well known to every one. We extract it from the Transactions of the Society of Arts, &c.

"The timber of the teak-tree is in India what the oak is in England: it is, however, unnecessary to enlarge on their comparative value, because oak will not grow in India. Our attention ought therefore to be confined to teak alone; not only as being by far the best wood we yet know of in this country for ship-building, but also for the house carpenter, and almost every other work where strong, durable, easily-wrought, light wood is required. The advantages to be derived from the cultivation of so valuable a tree, where nature has not bestowed it, must therefore be obvious to every one; particularly in Bengal, where it grows well, and the demand is so great. The teak-tree is a native of Pegu.

"Government, sensible of what is here stated, have long given every possible encouragement for an extensive propagation. But to render it still more general, the native land-holders must

* See the ensuing book, for the singular properties of this insect.

be made sensible of the advantage they may expect to derive from large plantations thereof.

"The growth of the tree is rapid, and at all ages the wood (from various experiments) appears excellent. Some trees in the Honourable Company's Botanic Garden, brought from the Rajahmundry Circar, in 1787, were, in 1804, from three to upwards of four feet in girth, at three and a half feet above ground, and high in proportion. These plants were about twelve months old when sent from the coast, so that their present age is about seventeen years. A tree promising so much advantage, in so short a space, compared to what the oak requires in England to become serviceable in the marine yard, makes it highly worthy of every attention and encouragement. A few observations on rearing the plants from the seed seem necessary, as I have often known seeds from the same tree succeed with one person, and totally fail with another.

"The nut in which the seeds are lodged is exceeding hard, contains four cells, and in each is lodged a single small seed. It has been ascertained, that they perfectly retain their vegetating power in the growth, even as far as eighteen months; however, it is advisable to sow them about the beginning of the first periodical rains, or north-westers, after they are taken ripe from the tree in October. If sown about this period, or rather before than after, in well-shaded beds, about an inch asunder, and covered with about a quarter of an inch of earth, with a little rotten straw or grass spread over the earth, to keep the beds in an uniform state of humidity, by gentle waterings, should the weather prove dry; most of the nuts will be found to produce from one to four plants, in from four to eight weeks. However, it sometimes happens, that many will remain in the ground until the commencement of the second rains, nay even of the third; however this is rare, yet it will be advisable to sow the seed on a spot that can be spared, at least until the rains of the second season are well advanced; by not attending to this circumstance, many have thought the seed bad, consequently caused the ground to be dug up for other purposes.

"The plants, when they first make their appearance, are very small, scarce so large as a cabbage plant when it first springs from the earth; their growth is, however, rapid. When they are about

one or two inches high, they ought to be transplanted into other beds, at the distance of about six inches from each other, there to remain until the beginning of the next year's rains, when they are to be planted out to where they are to remain; or they may, when from two to four inches high, be planted out at once to where they are to grow: and it is not perfectly clear but by so doing they succeed better; as in taking up plants of any considerable size, say from one to two or more feet high, the roots are very apt to be injured, particularly the sap root, which retards their growth much, nay often kills them.

"About Calcutta they thrive luxuriantly in most places where they have been tried, and any tolerable degree of care taken of them; so that the only observations which seem necessary to be made on this head, are to avoid sowing the seed, or planting in such places as are low, or subject to be inundated; to keep them clear from weeds, and sparingly watered during dry weather, for the first year only. In a good soil, not much overrun with that coarse white-flowered grass, called by the natives woola (saccharum), they will scarce require any care whatever, after the first six months; from the time of being planted out where they are to stand. They will then be about eighteen months old, supposing them to have been transplanted twice, and in that time they will, in general, be from five to ten feet high, according as the soil is favourable, and out of all danger, except from north-westers.

"With respect to the distance at which plants ought to stand in plantations, every one's judgment can direct. The oak requires a great space, as the crooked parts thereof are the most valuable, and required for the knees and other curved timber in ship-building; but teak is naturally a straight-grained tree, and only used in Bengal, or at least in general, for the straight work; sissoo being commonly employed for knees, and other crooked timber; hence it may be concluded, that the straighter the teak trees grow, the more eligible for every purpose for which this timber is generally employed in Bengal. They do not, therefore, require to be planted at a great distance; suppose from six to ten feet, in quincunx order; by being so close they grow straighter, and protect one another while young, which is particularly wanted where violent gusts of wind, such as our north-westers, prevail. When the trees grow up, they can be thinned out to advantage, as the

timber of the young trees will answer for a variety of uses. The seed of this tree we have now in such abundance as to render a few hundred plants, in the hundred biggahs, of little or no importance; and if the ground on which they are planted is not of the best sort, the more necessity there is for planting close."

[*Pantolog. Roxburgh. Trans. Arts, Commerce, &c.*

SECTION XI.

Tobacco.

Nicotiana Tabacum.—Linn.

This well known plant was first imported into Europe about the middle of the sixteenth century, by Hernandez de Toledo, who sent it to Spain and Portugal, at which time M. Nicot was residing at the court of Lisbon, as ambassador from Francis II.; in consequence of which he carried the tobacco plant with him into France, in 1560, and presented it to Catharine de Medicis, as a production of the new world. From the name of the Ambassador it was called Nicotiana. It appears from Lobel, that this plant was cultivated in Britain previous to the year 1570; and the introduction of the custom of smoking it in England is ascribed to Sir Walter Raleigh. The cultivation of tobacco is now common to various parts of the globe; and though prohibited by the laws of this country, still the manufacture of it forms no inconsiderable branch of commerce. The vulgar name of tobacco it has obtained from Tobaco, a province of Yucatan, in South America, where it was first discovered.

There are two varieties of that species of nicotiana which is cultivated for common use; and which are distinguished by the names of Oronokoe, and sweet-scented tobacco. They differ from each other in the figure of their leaves; those of the former being longer and narrower than the latter. They are tall herbaceous plants, growing erect, with fine foliage, and raising with a strong stem from six to nine feet high. The stalk, near the root, is upward of an inch diameter, and surrounded with a kind of hairy or velvet clammy substance, of a yellowish-green colour. The leaves are rather of a deeper green, and grow alternately at the distance of two or three inches from each other. They are oblong, of a spear-shaped oval, and simple; the largest about

twenty inches long, but decreasing in size as they ascend, till they come to be only ten inches long, and about half as broad. The face of the leaves is much corrugated, like those of spinach when full ripe. Before they come to maturity, when they are about five or six inches long, the leaves are generally of a full green, and rather smooth; but as they increase in size, they become rougher, and acquire a yellowish cast. The stem and branches are terminated by large bunches of flowers, collected into clusters, of a delicate red; the edges, when full blown, inclining to a pale purple. They continue in succession till the end of the summer; when they are succeeded by seeds of a brown colour, and kidney-shaped. These are very small, each capsule containing about 1000; and the whole produce of a single plant is reckoned at about 350,000. The seeds ripen in the month of September.

Mr. Carver informs us, that the Oronokoe, or, as it is called, the long Virginian tobacco, is the kind best suited for bearing the rigour of a northern climate; the strength, as well as the scent, of the leaves, being greater than that of the other. The sweet-scented sort flourishes most in a sandy soil, and in a warm climate, where it greatly exceeds the former in the celerity of its growth; and is likewise, as its name intimates, much more mild and pleasant.

Culture.—Tobacco thrives best in a warm, kindly, rich soil, that is not subject to be overrun by weeds. In Virginia the soil in which it thrives best is warm, light, and inclining to be sandy; and therefore if the plant is to be cultivated in Britain, it ought to be planted in a soil as nearly of the same kind as possible. Other kinds of soil might probably be brought to suit it, by a mixture of proper manure; but we must remember, that whatever manure is made use of must be thoroughly incorporated with the soil. The best situation for a tobacco-plantation is the southern declivity of a hill, rather gradual than abrupt, or a spot that is sheltered from the north winds: but at the same time it is necessary that the plants enjoy a free air; for without that they will not prosper.

Having sown the seed, on the least apprehension of a frost after the plants appear, it will be necessary to spread mats over the beds, a little elevated from the ground by poles laid across, that they may not be crushed. When the tobacco has risen to the height of more than two feet, it commonly begins to put forth the

branches on which the flowers and seeds are produced; but as this expansion, if suffered to take place, would drain the nutriment from the leaves, which are the most valuable part, and thereby lessen their size and efficacy, it becomes needful at this stage to nip off the extremity of the stalk, to prevent its growing higher. In some climates the top is commonly cut off when the plant has fifteen leaves: but if the tobacco is intended to be a little stronger than usual, this is done when it has only thirteen.

The apparent signs of maturity are these: the leaves, as they approach a state of ripeness, become more corrugated or rough: and when fully ripe appear mottled, with yellowish spots on the raised parts; whilst the cavities retain their usual green colour.

Tobacco is subject to be destroyed by a worm; and without proper care to exterminate this enemy, a whole field of plants may soon be lost. This animal is of the horned species, and appears t be peculiar to the tobacco-plant; so that in many parts of America it is distinguished by the name of the tobacco-worm. In what manner it is first produced, or how propagated, is unknown: but it is not discernible till the plants have attained about half their height; and then appears to be nearly as large as a gnat. Soon after this it lengthens into a worm; and by degrees increases in magnitude to the bigness of a man's finger. In shape it is regular from its head to its tail, without any diminution at either extremity. The colour of its skin is, in general, green, interspersed with several spots of a yellowish white; and the whole covered with a short hair scarcely to be discerned. These worms are fou d the most predominant during the end of July and the beginning of August; at which time the plants must be particularly attended to, and every leaf carefully searched. As soon as a wound is discovered (and it will not be long before it is perceptible), care must be taken to destroy the cause of it, which will be found near it, and from its unsubstantial texture may easily be crushed.

When the tobacco is fit for being gathered, on the first morning that promises a fair day, before the sun is risen, take an axe, or a long knife, and holding the stalk near the top with one hand, sever it from its root with the other, as low as possible. Lay it gently on the ground, taking care not to break off the leaves, and there let it remain exposed to the rays of the sun throughout the day, or until the leaves, according to the American expression,

are entirely wilted; that is, till they become limper, and will bend any way without breaking. But if the weather should prove rainy, without any intervals of sunshine, and the plants appear to be fully ripe, they must be housed immediately. This must be done, however, with great care, that the leaves, which are in this state very brittle, may not be broken. They are next to be placed under proper shelter, either in a barn or covered hovel, where they cannot be affected by rain, or too much air, thinly scattered on the floor; and if the sun does not appear for several days, they must be left to wilt in that manner; but in this case the quality of the tobacco will not be quite so good.

When the leaves have acquired the above-mentioned flexibility, the plants must be laid in heaps, or rather in one heap if the quantity is not too great, and in about twenty-four hours they will be found to sweat. But during this time, when they have lain for a little while, and begin to ferment, it will be necessary to turn them; bringing those which are in the middle to the surface, and placing those which are at the surface in the middle. The longer they lie in this situation, the darker-coloured is the tobacco. After they have lain for three or four days, for a longer continuance might make the plants turn mouldy, they may be fastened together in pairs, with cords or wooden pegs, near the bottom of the stalk, and hung across a pole, with the leaves suspended in the same covered place, a proper interval being left between each pair. In about a month the leaves will be thoroughly dried, and of a proper temperature to be taken down. This state may be ascertained by their appearing of the same colour with those imported from America. But this can be done only in wet weather. The tobacco is exceedingly apt to attract the humidity of the atmosphere, which gives it a pliability that is absolutely necessary for its preservation; for if the plants are removed in a very dry season, the external parts of the leaves will crumble into dust, and a considerable waste will ensue.

Cure.—As soon as the plants are taken down, they must again be laid in a heap, and pressed with heavy logs of wood for about a week; but this climate may possibly require a longer time. While they remain in this state it will be necessary to introduce your hand frequently into the heap, to discover whether the heat is not too intense; for in large quantities this will sometimes be

the case, and considerable damage will be occasioned by it. When they are found to heat too much; that is, when the heat exceeds a moderate glowing warmth, part of the weight by which they are pressed must be taken away; and the cause being removed, the effect will cease. This is called the second, or last, sweating; and, when completed, which it generally will be about the time just mentioned, the leaves may be stripped from the stalks for use. Many, however, omit this last sweating.

When the leaves are stripped from the stalks, they are to be tied up in bunches or hands, and kept in a cellar or other damp place; though if not handled in dry weather, but only during a rainy season, it is of little consequence in what part of the house or barn they are laid up. At this period the tobacco is thoroughly cured, and as proper for manufacturing as that imported from the colonies.

Tobacco is made up into rolls by the inhabitants of the interior parts of America, by means of a machine called a tobacco-wheel. With this machine they spin the leaves after they are cured, into a twist of any size they think fit; and having folded it into rolls of about twenty pounds each, they lay it by for use. In this state it will keep for several years, and be continually improving, as it always grows milder. The Illinois usually form it into carrots; which is done by laying a number of leaves, when cured, on each other, after the ribs have been taken out, and rolling them round with packthread till they become cemented together. These rolls commonly measure about eighteen or twenty inches in length, and nine round in the middle part.

[*Bauhin. Long. Lobel. Gregory.*

SECTION XII.

Tallow-Tree.

Croton Sebiferum. Tomex Sebifera.—LINN.

Wax-Tree.

Myrica Cerifera.—LINN.

MOST plants produce a certain portion of oil; in some it appears thin and liquid when expressed, as that of the olive and the almond; in others sufficiently thick, and in sufficient abundance for common tallow, as the croton sebiferum, and tomex sebifera, both of which are, in consequence, denominated *tallow-tree*; and the myrica gale, which secretes it less freely; while the myrica cerifera secretes a still more concrete substance, of the nature of wax rather than of tallow, and which is used in America, where it grows indigenously, for this purpose.

The first two are natives of China; the former a monœcian polyandrian plant, with rhombic-ovate leaves, pointed, very entire, and glabrous; the latter a dodecandrian monogynian plant, with glabrous leaves, and corols without florets; it is about the height of a cherry tree, its leaves in form of a heart, of a deep shining red colour, and its bark very smooth. Its fruit is inclosed in a kind of pod, or cover, like a chesnut, and consists of three round white grains, of the size and form of a small nut, each having its peculiar capsule, and within a little stone. This stone is encompassed with a white pulp which has all the properties of true tallow, both as to consistence, colour, and even smell, and accordingly the Chinese make their candles of it; which would doubtless be as good as those in Europe, if they knew how to purify their vegetable, as well as we do our animal, tallow. All the preparation they give it, is to melt it down, and mix a little oil with it, to make it softer and more pliant. It is true their candles made of it yield a thicker smoke, and a dimmer light than ours; but those defects are owing in a great measure to the wicks, which are not of cotton, but only a little rod of dry light wood covered with the pith of a rush wound

round it; which, being very porous, serves to filtrate the minute parts of the tallow, attracted by the burning stick, which by this means is kept alive.

In like manner the Americans make wax candles of the waxy-berry of the myrica cerifera, or candle-berry myrtle, which burn with a fine clear light, for a long time, and possess a fragrant myrtle odour.

We are indebted to Dr. Bostock and Mr. Cadet for a very exact account of its properties and extraction. The myrica cerifera is a shrub which grows abundantly in Louisiana, and other parts of North America. It produces a berry about the size of a pepper-corn. A very fertile shrub yields nearly seven pounds. The berries are picked off, thrown into a kettle, and covered with water to the depth of about half a foot. The kettle is then boiled, and the berries stirred and squeezed against the side of the vessel. The wax which they contain is melted out, and swims on the surface. It is skimmed off, passed through a cloth, dried, melted again, and cast into cakes. From the observations of Cadet we learn that the wax forms the outer covering of the berries. The wax thus obtained is of a pale green colour. Its specific gravity is 1·0150. It melts at the temperature of 109°; when strongly heated it burns with a white flame, produces little smoke, and during the combustion emits an agreeable aromatic odour. Water does not act upon it. Alcohol, when hot, dissolves $\frac{1}{20}$th of its weight, but lets most of it fall again in cooling.

There is another species of the myrica, M. gale, found in many of the boggy mosses of our own country, that produces the same material. It is also obtained in South America, as we learn from M. Humboldt, from one or two of the palms, and especially the ceroxylon andicola.

There are, also, various other insects, besides the bee, that yield either wax, or a material very nearly resembling it; as the corcus lacca, or gum-lac insect, and perhaps one or two other species of this genus. There is, moreover, another waxy material, collected in a manner somewhat similar, in China, and which is called pela; well known to be the product of an insect, though the name of the insect is not well known.

It is probable, as we have observed already, that in all these cases the matter of wax is obtained by the insect from the vegetable king-

dom. And it has been usually supposed that it consists of the pollen which the bees visibly collect on their thighs, and afterwards elaborate in some unknown way. The great difference, however, between wax and this matter which the bees collect has been long remarked. When examined by the microscope, this little mass of pollen is obviously composed of a number of hard grains compressed together; and if it be laid on a hot plate, it does not melt as wax would do, but smokes, dries, and is reduced to a coal; and, if kindled, burns without melting. Some late and very curious experiments, however, of M. Huber, one of the most celebrated apiarists in Europe, have shewn that the pollen has no share whatever in the formation of wax; but that this substance is produced indiscriminately from honey, sugar, or any other saccharine matter, which serves as food for the bees. The details of these experiments would occupy too much space: it is sufficient to mention that they were performed by confining separate swarms of bees within their hives, and feeding one hive with honey, another with muscovado sugar, another with treacle, another with refined sugar; in all of which abundance of wax was produced; and, on the other hand, by feeding another hive with only pollen and fruits, no wax whatever was formed, though the bees remained a week in their confinement. Other observations and experiments by this ingenious naturalist still further explain this subject, by shewing what is the real use of the pollen; namely, to afford sustenance for the larve of the bee the moment it is hatched.

There is a vegetable wax which has lately been discovered in the Brazils, though the tree from which it is produced is not accurately known, that bids fair to prove an article of highly useful and extensive commerce between that country and our own. The only specimen of it which has been received in England, was transmitted to Lord Grenville from Rio de Janeiro, by the Comte de Galveas, as a new article lately brought to that city, from the northernmost parts of the Brazilian dominions, the capiteneas of Rio Grande and Seara, between the latitudes of three and seven degrees north: it is said to be the production of a tree of slow growth, called by the natives *carnauba*, which also produces a gum used as food for men, and another substance employed for fattening poultry.

When the Comte wrote to Lord Grenville in 1809, orders had been sent to the governors of the districts where it grows, requiring

them to report more particularly on the nature and qualities of this interesting tree; we may therefore hope that information will soon be obtained whether the article can be procured in abundance, and at a reasonable price: in which case it will become a valuable addition to the comforts of mankind, by reducing the price and improving the quality of candles, flambeaux, &c.

The article, in the state in which it was sent, resembles much that described by Humboldt, as the produce of the ceroxylon andicola; but it is not likely to be the same, as Humboldt's wax is collected from a stately palm tree, which grows on the high mountains, from 900 to 1450 toises above the level of the sea, and on the edge of the regions of perpetual snow. On the other hand, the Brazilian plant is described as a slow growing tree, but not as a large one, and there are no high mountains delineated in the most accurate and recent maps of the capiteneas where it is found. But a more decisive argument against their identity is the analysis of Vauquelin, published by Humboldt, which shows, that the produce of the ceroxylon consists of two-thirds resin and only one third wax; but the Brazilian article is entirely wax, and affords not the smallest trace of resin. The Brazilian plant, however, was not entirely unknown to Humboldt, for it appears from his book, that Mr. Correa had informed him, that a palm, called carnauba by the natives of Brazil, produced wax from its leaves.

The wax, in its rough state, is in the form of a coarse pale grey powder, soft to the touch, and mixed with various impurities, consisting chiefly of fibres of the bark of the tree, which, when separated by a sieve, amount to about forty per cent. It possesses the following characters, according to the analysis of Mr. Brande, as given in the Phil. Trans. for 1811.

"It has an agreeable odour, somewhat resembling new hay, but scarcely any taste.

"At 260° Fahrenheit it enters into perfect fusion, and in this state it may be further purified, by passing it through fine linen. By this process, it acquires a dirty green colour, and its peculiar smell becomes more evident. When cold, it is moderately hard and brittle. Its specific gravity is 0·980.

2. "Water exerts no action on the wax, unless boiled with it for some hours; it then acquires a slight brown tinge, and the peculiar odour of the wax.

3. "Alcohol does not dissolve any portion of the wax, unless heat be applied.

"Two fluid ounces of boiling alcohol, specific gravity 0·826, dissolve about ten grains of the wax, of which eight grains are deposited as the solution cools, and the remaining two grains may be afterward precipitated by the addition of water, or may be obtained unaltered by evaporating the alcohol.

"The solution of the wax in alcohol has a slight green tinge.

4 "Sulphuric ether, specific gravity 0·7563, dissolves a very minute portion of the wax, at the temperature of 60°.

"Two fluid ounces of boiling sulphuric ether dissolve thirty grains of the wax, of which twenty-six grains are deposited by cooling the solution, and the remaining four grains may be obtained by allowing the ether to evaporate spontaneously.

5. "The fixed oils very readily dissolve the wax at the temperature of boiling water, and form with it compounds of an intermediate consistence, very analogous to those which are obtained with common bees-wax."

From the detail of experiments, it appears, that, although the South American vegetable wax possesses the characteristic properties of bees'-wax, it differs from that substance in many of its chemical habitudes; it also differs from the other varieties of wax, namely, the wax of the myrica cerifera, of lac, and of white lac.

The attempts made by Mr. Brande to bleach the wax were conducted on a small scale; but from the experiments related, it appears, that, after the colour has been changed by the action of very dilute nitric acid, it may be rendered nearly white by the usual means. He had not had sufficient time to ascertain whether the wax can be more effectually bleached by long continued exposure; nor had he had an opportunity of submitting it to the processes employed by the bleachers of bees'-wax.

Perhaps the most important part of the present inquiry is that which relates to the combustion of the vegetable wax, in the form of candles.

The trials which have been made, to ascertain its fitness for this purpose, are extremely satisfactory; and when the wick is properly proportioned to the size of the candle, the combustion is as perfect and uniform as that of common bees'-wax.

The addition of from one-eighth to one-tenth part of tallow is

sufficient to obviate the brittleness of the wax in its pure state, without giving it any unpleasant smell, or materially impairing the brilliancy of its flame. A mixture of three parts of the vegetable wax, with one part of the bees-wax, also makes very excellent candles.

[*Humboldt and Bonplånd. Pantolog. Phil. Trans. Barton.*

CHAPTER VII.

EXTRANEOUS MARKS AND SUBSTANCES FOUND IN THE TRUNKS OF TREES.

In a preceding section, on the physiology of plants, it has been observed, that the trunk consists of hard wood, constituting its heart; soft wood or alburnum; inner bark or liber; and outer bark or cortex: and that the hard wood is produced and increased by an annual formation of new alburnum or liber. Wildenow supposes the latter; and that the liber of the one year is in the next converted into alburnum, and the alburnum of the same year into hard wood. Mr. Knight conceives the liber is not concerned in this conversion, and that the alburnum alone is converted into hard wood. In either case, it is easy to foresee that any durable marks or foreign substances introduced through the bark of the tree down into the soft wood, must necessarily, as this wood becomes converted into hard wood, and covered with new annual layers of soft wood, be transferred by degrees towards the interior of the trunk, and be found in the hard wood, or heart of the tree, instead of in the alburnum or external part.

We hear curious accounts of letters, rude cuts or engravings, and foreign bodies, being found in the middle, or near the middle, of the trunks of many trees; to the great astonishment of those who have made the discovery, and have not been aware of the true nature of the growth of the trunk, which we have thus endeavoured to point

out. The following we select from the Philosophical Transactions, as sufficient examples of this curious fact.

1. *Letters found in the Middle of a Beech.*

By J. Theodorie Klein, Secretary of Dantzick, F.R.S.

In the year 1727, a beech-tree was felled near Elbing, for the domestic use of John Maurice Mœller, then post-master of Elbing, now secretary of his native city. The trunk being sawed into pieces, one of these, three Dantzic feet six inches long, cleft in the house, discovered several letters in the wood, about one inch and a half from the bark, and near the same distance from the centre of the trunk. Two of these DB, show their old bark smooth and sound. The wood lying between the letters and the bark of the trunk, as well as that between the letters and the heart of the tree, is likewise solid and sound, bearing not the least trace of letters. The characters ᴚᴅ, being somewhat hollow, receive the mark of the letters DB.

The same letters are seen in the bark of the tree, only that they are partly ill shaped, partly almost effaced; whereas those within bear a due proportion, as if done with a pencil.

It is an ancient custom to cut names, and various characters, on the rinds of trees, especially on such as are smooth. That this has happened to our beech, the mere inspection of the bark sufficiently shows. An incision made, the tubuli conveying the nutritious juice, and the utriculi in which it is prepared, are divided and lacerated, and more of them, as the incision was made deeper and wider: and consequently the sap is not carried on in the circulation, but extravasated and stopped at the wounds. Hence the origin of the characters in the bark and wood.

Now as a new circle of fibres grows yearly on the tree, between the wood and bark, a number of these may, in a process of years, more and more surround the engraved characters, and at length cover them. And this number was the greater in our beech, on account of better than half a century elapsed since the incision, which was made in the year 1672, as appears on the outside of the bark. But while new circles of fibres are successively added, the tunicle or skin of the bark is broken each time, and the utriculi extended and dilated.

M. Klein also mentions several other instances of the same kind, and accounted for in the same manner, as treated of by different authors; viz. Solomon Reisel, John Meyer, Luke Schrœck, John Chrit. Gottwald, John James Scheuchzer, and John Melch. Verdries.

2. *Large Deer's Head found in the Heart of an Oak.*

Sir John Clark, F.R.S.

BEING lately in Cumberland, Sir J. C. there observed three curiosities in Winfield-Park, belonging to the Earl of Thanet. The first was a huge oak, at least sixty feet high, and four in diameter, on which the last great thunder had made a very odd impression; for a piece was cut out of the tree, about three inches broad, and two inches thick, in a straight line from top to bottom. The second was, that in another tree of the same height, the thunder had cut out a piece of the same breadth and thickness, from top to bottom, in a spiral line, making three turns about the tree, and entering into the ground above six feet deep. The third was the horn of a large deer found in the heart of an oak, which was discovered on cutting down the tree. It was found fixed in the timber with large iron cramps; it seems therefore, that it had at first been fastened on the outside of the tree, which in growing afterwards had inclosed the horn. In the same park Sir John saw a tree thirteen feet in diameter.

3. *Remarks on the foregoing.*

By Dr. Mortimer.

THIS horn of a deer, found in the heart of an oak, and fastened ith iron cramps, is one of the most remarkable instances of this kind, it being the largest extraneous body we have any where recorded, thus buried, as it were, in the wood of a tree. If J. Meyer, and J. Pet. Albrech had seen this, they could not have imagined the figures seen by them in beech-trees to have been the sport of nature, but must have confessed them to have been the sport of an idle hand. To the same cause are to be ascribed those figures of crucifixes, Virgin-Marys, &c. found in the heart of trees; as, for example, the figure of a crucifix, which I saw at Maestricht, in the

church of the White Nuns of the order of St. Augustin, said to be found in the heart of a walnut-tree, on its being split with lightning. And it being usual in some countries to nail small images of our Saviour on the cross, of Virgin-Marys, &c. to trees by the road-side, in forests, and on commons; it would be no greater a miracle to find any of these buried in the wood of the tree, than it was to find the deer's horn so lodged.

Sir Hans Sloane, in his noble museum, has a log of wood brought by Mr. Cunningham from an island in the East-Indies, which, on being split, exhibited these words in Portuguese, DA BOA ORA. i. e. Det [Deus] bonam horam.

[*Editor. Phil. Trans.* 1739, Vol. XLI.

CHAPTER VIII.

FAIRY RINGS.

THIS curious phenomenon has been differently accounted for. The following is Mr. Nicholson's description and explanation: "the appearance in the grass," says he, "commonly called Fairy Rings, is well known. It consists either of a ring of grass of more luxuriant vegetation than the rest, or a kind of circular path in which the vegetation is more defective than elsewhere. It appears to be pretty well ascertained, that the latter state precedes the former. Two causes are assigned for this phenomenon: the one, which cannot be controverted, is the running of a fungus; the other, which has been considered as an effusion of theory, is grounded on a supposition that the explosion of lightning may produce effects of the same kind on the ground, as Dr. Priestley's battery was found to produce on the polished surface of a plate of metal, that is to say, a series of concentric rings. Some observations, which I find in my common-place book, appear to show that this last effect may, in certain circumstances, take place.

"On Tuesday the 19th of June, 1781, a very powerful thunder-

Engraved by Hay, from a Drawing by Craig — *For the Gallery of Nature & Art*

FAIRY RING, IN THE DINGLE, NEAR SHREWSBURY.

London, Published by R. Wilks, 89, Chancery Lane

storm passed over the western extremity of London. I was then at Battersea, and made no other remark on the phænomena than that the explosions, which were very marked and distinct, were in many instances forked at the lower end, but never at the top; whence it follows, that the clouds were in the positive state for the most part. On the following Sunday, namely the 24th, I happened to be n Kensington Gardens; in every part of which extensive piece of ground the lightning had left some marks of its agency, chiefly by discoloration of the grass in zigzag streaks, some of which were fifty or sixty yards in length. Instances of this superficial course of the lightning along the ground, before it enters the earth, are sufficiently frequent. But the circumstances which attracted my attention the most was seen in a small grove of trees at the angular point of one of the walks."

[*Journal of Natural Philosophy, Vol. I. p.* 546.

Dr. Darwin is well known to have been one of the chief advocates for this electrical hypothesis. It is thus he adverts to it in his Botanic Garden, Canto I. l. 369:

So from dark clouds the playful lightning springs,
Rives the firm oak, or PRINTS THE FAIRY-RINGS.

Upon which he has the following note towards the end of the volume:

"There is a phenomenon, supposed to be electric, which is yet unaccounted for; I mean the Fairy-rings, as they are called, so often seen on the grass. The numerous flashes of lightning which occur every summer are, I believe, generally discharged upon the earth, and but seldom (if ever) from one cloud to another. Moist trees are the most frequent conductors of these flashes of lightning, and I am informed by purchasers of wood that innumerable trees are thus cracked and injured. At other times larger parts or prominences of clouds gradually sinking as they move along, are discharged on the moister parts of grassy plains. Now this knob or corner of a cloud, in being attracted by the earth will become nearly cylindrical, as loose wool would do when drawn out into a thread, and will strike the earth with a stream of electricity perhaps two or ten yards in diameter. Now, as a stream of electricity displaces the air it passes through, it is plain no part of the grass can be burnt

by it, but just the external ring of this cylinder, where the grass can have access to the air; since without air nothing can be calcined. This earth after having been so calcined becomes a richer soil, and either funguses or a bluer grass for many years mark the place. That lightning displaces the air in its passage is evinced by the loud crack that succeeds it; which is owing to the sides of the aerial vacuum clapping together when the lightning is withdrawn. That nothing will calcine without air is well understood, from the acids produced in the burning of phlogistic substances, and may be agreeably seen by suspending a paper on an iron prong, and putting it into the centre of the blaze of an iron furnace; it may be held there some seconds, and may be again withdrawn, without its being burnt, if it be passed quickly into the flame, and out again, through the external part of it which is in contact with the air. I know some circles of many yards diameter of this kind near Foremark, in Derbyshire, which annually produce large white funguses and stronger grass; and have done so, I am informed, above thirty years. This increased fertility of the ground by calcination or charring, and its continuing to operate so many years, is well worth the attention of the farmer; and shews the use of paring and burning new turf in agriculture, which produces its effect, not so much by the ashes of the vegetable fibres, as by charring the soil which adheres to them.

These situations, whether from eminence or from moisture, which were proper once to attract and discharge a thunder-cloud, are more liable again to experience the same. Hence many fairy-rings are often seen near each other, either without intersecting each other, as I saw this summer in a garden in Nottinghamshire, or intersecting each other, as described on Arthur's seat, near Edinburgh, in the Edinb. Trans. Vol. II. p. 3."

[*Bot. Gard. Additional Note xiii. p.* 26.

There are, nevertheless, various objections to this hypothesis; and which seem rather to establish the opinion that these singular patches are the result of the insidious operation of the *agaricus orcades*, a fungus common to the moist wastes of our own country. Mr. Gilbert White first observed, with his usual correctness, that the cause of the Fairy-rings exists in the turf, and is conveyable with it; "for the turf of my garden walks," says he, "brought from the down above, abounds with these appearances, which vary

their shape, and shift their situation continually, discovering themselves now in circles, now in segments, and sometimes in irregular patches and spots. Wherever they obtain, PUFF-BALLS ABOUND; the seeds of which were doubtless brought in the turf."

[*Nat. Hist. Vol. II. p.* 259.

This puff-ball has been very plausibly stated, and nearly ascertained, by Dr. Withering, to be that of the agaric we have above referred to. An able writer in the Monthly Magazine, for April, 1803, whilst he embraces this latter opinion, states several very forcible reasons against the electrical hypothesis.

"However plausible," says he, "this idea (that of electricity) may seem to the theoretical philosopher, it is found by the observant naturalist to be inadequate to the explication of the phenomenon. Without intending to enter into any kind of controversy upon this subject, which, doubtless, will be thought by some readers already to have occupied too many pages of the most popular miscellanies, allow me to mention a few facts which appear irreconcilable with the above-mentioned theory.

"Moisture is stated as requisite for the attraction of lightning to turf—but fairy-rings are discoverable in situations which have no pretensions to moisture.

"It is next observed, that the cloud attracted by moisture, will become cylindrical, or conical; and consequently the stream of electricity descending on the turf, by its external ring will there form the circular mark vulgarly called a fairy-ring; but instead of these marks being uniformly circular, which they would be from such a cause, they, as Mr. White accurately states, 'vary their shape, and shift situation continually, discovering themselves now in circles,' (though seldom entire) 'now in segments, and sometimes in irregular patches and spots.'

The gradual shifting of situation furnishes another objection to the phenomenon's being occasioned by lightning; as does the not mere permanency, or decrease, or dying out, of such marks, but the annual increase of size which may be frequently noticed in some; and the fact that fairy-rings originate in small patches, militates strongly against such a theory.

"It is urged on the above hypothesis, that in the rings formed by lightning the turf is thereby calcined—but it must occur to every one

that where lightning falls so powerfully as to calcine turf, some effect will be perceptible on the substrata of soil, or gravel, &c. for even quartz, has been vitrified by lightning; but that no similar effect in any degree is to be discovered under fairy-rings, either recent or old, has been ascertained by accurate examination.

Instead of troubling you with any further observations of my own, in refutation of the above theory, permit me to close with a quotation from the accurate botanical work of the late Dr. Withering; in which, after describing the agaricus orcades, the author explains the phenomenon of fairy-rings in a more satisfactory manner than has been done by any other writer.

" I am satisfied that the rare and brown, or highly-clothed and verdant circles, in pasture fields, called fairy-rings, are caused by the growth of this agaric. We have many of them in Edgbaston Park, on the side of a field sloping to the south-west, of various sizes; but the largest, which is eighteen feet in diameter, and about as many inches broad in the periphery, where the agarics grow, has existed for some years on the slope of an adjoining pasture-field, facing the south. The soil is there on a gravelly bottom. The larger circles are seldom complete. The large one just now described, is more than a semi-circle, but this phenomenon is not strictly limited to a circular figure. Where the ring is brown and almost bare, upon digging up the soil, to the depth of about two inches, the spawn of the fungus will be found of a greyish white colour; but where the grass has again grown green and rank, I never found any of the spawn existing. A similar mode of growth takes place in some of the crustaceous lichens, particularly in the *L. centrifugus*, which spreads from a center to the circumference, and gradually decays in the middle; an observation made by Linnéus, and which is equally applicable to the general tendency of growth in the agaricus orcades."

[*Monthly Mag. vol. xv. Editor.*

CHAP. IX.

PREPARATION AND USE OF AN HERBARIUM, OR HORTUS SICCUS.

THE advantages of preserving specimens of plants, as far as it can be done, for examinations at all times and seasons, is abundantly obvious. Notwithstanding the multitude of books filled with descriptions and figures of plants, and however ample or perfect such may be, they can teach no more than their authors observed; but when we have the works of Nature before us, we can investigate them for ourselves, pursuing any train of inquiry to its utmost extent, nor are we liable to be misled by the errors or misconceptions of others. A good practical botanist must be educated among the wild scenes of nature; while a finished theoretical one requires the additional assistance of gardens and books, to which must be superadded the frequent use of a good herbarium. When plants are well dried, the original forms and positions of even their minutest parts, though not their colours, may at any time be restored by immersion in hot water. By this means, the productions of the most distant and various countries, such as no garden could possibly supply, are brought together at once under our eyes, at any season of the year. If these be assisted with drawings and descriptions, nothing less than an actual survey of the whole vegetable world, in a state of nature, could excel such a store of information.

Some persons recommend the preservation of specimens in weak spirits of wine, and this mode is by far the most eligible for such as are very juicy. But it totally destroys their colours, and often renders their parts less fit for examination than the above-mentioned mode. It is besides incommodious for frequent study, and a very expensive and bulky way of making an herbarium.

The greater part of plants dry with facility between the leaves

of books, or other paper, the smoother the better. If there be plenty of paper, they often dry best without shifting; but if the specimens are crowded, they must be taken out frequently, and the paper dried before they are replaced. The great point to be attended to is, that the process should meet with no check. Several vegetables are so tenacious of their vital principle, that they will grow between papers, the consequence of which is a destruction of their proper habit and colours. It is necessary to destroy the life of such, either by immersion in boiling water, or by the application of a hot iron, such as is used for linen, after which they are easily dried. I cannot however approve of the practice of applying such an iron, as some persons do, with great labour and perseverance, till the plants are quite dry, and all their parts incorporated into a smooth flat mass. This renders them unfit for subsequent examination, and destroys their natural habit, the most important thing to be preserved. Even in spreading plants between papers, we should refrain from that precise and artificial disposition of their branches, leaves, and other parts, which takes away from their natural aspect, except for the purpose of displaying the internal parts of some one or two of their flowers, for ready observation.

After all we can do, plants dry very variously. The blue colours of their flowers generally fade, nor are reds always permanent. Yellows are much more so, but very white flowers retain their natural aspect. The snowdrop and parnassia, if well dried, continue white. Some greens are much more permanent than others; for there are some natural families whose leaves, as well as flowers, turn almost black by drying; as melampyrum, bartsia, and their allies, several willows, and most of the orchideæ. The heaths and firs in general cast off their leaves between papers, which appears to be an effort of the living principle, for it is prevented by immersion of the fresh specimen in boiling water. Nandina domestica, a Japanese shrub, in troduced among us by Lady A. Hume, and Mr. Evans, of Stepney, is very remarkable in this respect. Every leaflet of its very compound leaves separates from its stalk in drying, and those stalks all fall to pieces at their joints.

Dried specimens are best preserved by being fastened, with weak carpenter's glue, to paper, so that they may be turned over without damage. Thick and heavy stalks require the additional support of

a few transverse slips of paper, to bind them more firmly down. A half sheet, of a convenient folio size, should be allotted to each species, and all the species of a genus may be placed in one or more whole sheets. On the latter the name of the genus should externally be written, while the name of every species, with its place of growth, time of gathering, the finder's name, or any other concise piece of information, may be inscribed on its appropriate paper. This is the plan of the Linnæan Herbarium, in which every species, which its original possessor had before him when he wrote his great work, the Species Plantarum, is numbered both in pencil and in ink, as well as named, the former kind of numbers having been temporary till the book to which they refer was printed; after which they were confirmed with a pen, and a copy of the book, now also in my hands, was marked in reference to them. Here therefore we do not depend on the opinion merely, even of Linnæus, for we have always before our eyes the very object which was under his inspection. We have similar indications of the plants described in his subsequent works, the herbarium being most defective in those of his second Mantissa, his least accurate publication. We often find remarks there, made from specimens acquired after the Species Plantarum was published. These the herbarium occasionally shows to be of a different species from the original one, and it thus enables us to correct such errors.

The specimens thus pasted, are conveniently kept in lockers, or on the shelves of a proper cabinet. Linnæus, in the Philosophia Botanica, exhibits a figure of one, divided into appropriate species for each class, which he supposed would hold his whole collection. But he lived to fill two more of equal size, and his herbarium has been perhaps doubled since his death, by the acquisitions of his son and of its present possessor.

One great and mortifying impediment to the perfect preservation of an herbarium arises from the attacks of insects. A little beetle, called ptinus fur, is, more especially, the pest of collectors; laying its eggs in the germens or receptacles of flowers, and others of the more solid parts, which are speedily devoured by the maggots when hatched, and by their devastations paper and plants are alike involved in ruin. The most bitter and acrid tribes, as Euphorbia, Gentiana, Prunus, the syngenesious class, and especially willows, are preferred by these vermin. The last-mentioned family can

scarcely be thoroughly dried, before it is devoured. Ferns are scarcely ever attacked, and grasses but seldom.—To remedy this inconvenience, I have found a solution of corrosive sublimate of mercury in rectified spirits of wine, about two drams to a pint, with a little camphor, perfectly efficacious. It is easily applied with a camel-hair pencil when the specimens are perfectly dry, not before; and if they are not too tender, it is best done before they are pasted, as the spirit extracts a yellow dye from many plants, and stains the paper. A few drops of this solution should be mixed with the glue used for pasting. This application not only destroys, or keeps off all vermin, but it greatly revives the colours of most plants, giving the collection a most pleasing air of freshness and neatness. After several years' experience, I can find no inconvenience from it whatever; nor do I see that any dried plants can long be preserved without it.

The herbarium is best kept in a dry room without a constant fire. Linnæus had a stone building for his museum, remote from his dwelling-house, into which, I have been told, neither fire nor candle was ever admitted; yet nothing can be more free than his collection from the injuries of dampness, or other causes of decay.

[*Smith's Introduction to Physiological and Systematical Botany.*

THE

GALLERY

OF

NATURE AND ART.

PART I.

NATURE.

BOOK IV.

ZOOLOGY.

CHAPTER I.

CLASSIFICATION AND ARRANGEMENT OF ANIMALS.

IT is not our intention to take any notice, in the present edition of the *Gallery of Nature and Art,* of the different varieties of the human race, the causes of those varieties, or the customs and manners which have distinguished different ages and countries; though, if it should meet with that success which the encouragement so liberally afforded it seems powerfully to prognosticate, we shall follow it up with other supplementary volumes to that effect. At present, however, we shall confine ourselves to a brief survey of the more singular and curious of the inferior animals that are scattered over the face of the globe.

In consequence of the number of these animals, it would be impossible for mankind to distinguish them from one another, or to gain any considerable knowledge of their relative nature and habits,

if they did not exhibit remarkable differences which render it easy to establish distinctions among them. Hence zoologists have always been attentive to these differences, and by dividing animals accordingly, either into more or fewer classes, have conveniently formed what are called methods. It is certain, indeed, that no such classifications exist in nature, where all the various individuals constitute one continued and uninterrupted chain; yet they considerably assist the memory, and may be rendered truly useful guides in the study of animated being. Methods are, therefore, to be considered as instruments suited to our weakness, which may be beneficially resorted to, in tracing the wide field over which the stores of nature lie strewed in an immeasurable harvest.

The divisions which Aristotle adopted were very general and simple, being chiefly taken from the external characters of form, food, habit, or habitation: he did not, indeed, conceive that in his age zoology was sufficiently advanced for any thing of comprehensive or methodical arrangement; but he was sufficiently sensible of its advantages, and strongly recommended to succeeding naturalists a minute attention to the internal as well as the external organs of animals; and it is upon this recommendation that most of the systems of modern times have been founded; as those of Gesner, Aldrovandi, Ray, Johnston, Charleton, Klein, Linnæus, Artedi, Brisson, Daubenton, Geoffroy, Cuvier, and Blumenbach: all of whom have flourished since the middle of the sixteenth century; most of whom have contributed something of importance to a scientific method of studying and distributing animals; and the most celebrated of whom are Ray, Linnæus, Cuvier, and Blumenbach.

The system of Ray is derived in its outlines from the recommendation of Aristotle, to attend to the different structures of different descriptions of animal life; and his observation that one of these differences consists in their possessing lungs and a sanguineous system, or their being destitute of lungs and exsanguineous. The Linnæan method is, for the most part, built upon this general arrangement of Mr. Ray, especially in regard to quadrupeds: it is, however, an extension of it, and certainly an improvement. That of M. Cuvier, in its subordinate divisions is founded upon both these; but, in its primary and leading distinctions, upon the nervous or sensorial, instead of upon the respiratory and sanguineous systems; all animals being, upon M. Cuvier's scheme, divided into

vertebrated and invertebrated; those furnished with a back-bone, or vertebral chain for the purpose of inclosing the spinal marrow, and those destitute of such a chain: the secondary divisions consisting of vertebrated animals with warm blood, or blood warmer than the surrounding medium; and vertebrated animals with cold blood, or blood colder than the surrounding medium: invertebrated animals with blood-vessels, and invertebrated animals without blood-vessels. The system of Blumenbach, in its general divisions, is the same as that of Cuvier, and merely differs in its orders, or other subdivisions.

It would be an useless task to run through the whole of the arrangements we have now referred to, and explained as to their principles. The scheme of Linnæus is at present the most popular; though that of Cuvier presses hard upon it, and may, perhaps hereafter take the lead of it: it is somewhat more abstruse, but considerably more definite; and offers a noble specimen of scientific ingenuity, applied to one of the noblest ranks of scientific study. It is to these two methods, therefore, that we shall chiefly confine ourselves.

Linnæus divides the whole animal kingdom into six classes. The characters of these six classes are taken from the internal structure of animals, in the following manner:

Class 1. Mammalia, or Mammals, includes all animals that suckle their young. The characters of this class are these: the heart has two ventricles and two auricles; the blood is red and warm; and the animals belonging to it are viviparous.

Class 2. Aves, or birds. The characters are the same with those of class 1. excepting that the animals belonging to it are oviparous.

Class 3. Amphibia, or amphibious animals. The heart has but one ventricle and one auricle; the blood is red and cold; and the animals belonging to this class have the command of their lungs, so that the intervals between inspiration and exspiration are in some measure voluntary.

Class 4. Pisces, or fishes. The heart has the same structure, and the blood the same qualities, with those of the amphibia; but the animals belonging to this class are easily distinguished from the amphibia, by having no such voluntary command of their lungs, and by having external branchiæ or gills.

Class 5. Insecta, or insects. The heart has one ventricle, but no

auricle; the blood is cold and white; and the animals are furnished with antennas or feelers.

Class 6. Vermes, or worms. The characters are the same with those of class 5. only the animals have no antennæ, and are furnished with tentacula.

The first class, Mammalia, is subdivided into seven orders; the characters of which are taken from the number, structure, and situation of the teeth.

Order 1. Primates: these have four incisores, or fore-teeth, in each jaw, and one dog-tooth. N. B. By one dog tooth, Linnæus means one on each side of the fore-teeth in both jaws. This order includes four genera, viz. homo, simia, lemur, vespertilio.

Order 2. Bruta: these have no fore-teeth in either jaw. This order includes seven genera, viz. rhinoceros, elephas, trichechus, bradypus, myrmecophaga, manis, dasypus.

Order 3. Feræ: these have, for the most part, six conical fore-teeth in each jaw. This order includes ten genera, viz. phoca, canis felis, viverra, mustela, ursus, didelphus, talpa, sorex, erinaceus.

Order4. Glires: these have two fore-teeth in each jaw, and no dog-teeth. This order includes ten genera, viz. hystrix, lepus, castor, mus, sciurus, myoxus, cavia, arotomys, dypus, horox.

Order 5. Pecora: these have no fore-teeth in the upper jaw, but six or eight in the under jaw. This order includes eight genera, viz. camelus, moschus, giraffa, cervus, antelope, capra, ovis, bos.

Order 6. Belluæ: these have obtuse fore teeth in each jaw. This order includes four genera, viz. equus, hippopotamus, sus, tapir.

Order 7. Cete, or whale kind these have no uniform character in their teeth, being very different in the different genera; but are sufficiently distinguished from the other orders of mammalia, by living in the ocean, having pectoral fins, and a fistula or spiraculum upon the head. This order includes four genera, viz. monodon, balæna, physeter, delphinus.

The generic characters of the mammalia are, like those of the orders, almost entirely taken from the teeth, excepting in the vespertilio; which, besides the character of the order derived from the teeth, has this farther mark, that there is a membrane attached to the feet and sides, by means of which the creature is enabled to fly:

the hystryx, whose body is covered with sharp spines: and the whole order of pecora, whose genera, besides the characters taken from the teeth, are distinguished into those which have horns, those which have no horns, and by peculiarities in the horns themselves.

The specific characters are very various, being taken from any part of the body which possesses a peculiar uniform mark of distinction. As examples of these characters are to be found under the proper name of each genus, it is unnecessary to say any thing further concerning them in this place.

The second class, Aves, is subdivided into six orders; the characters of which are taken chiefly from the structure of the bill.

Order 1. The accipitres have a hooked bill, the superior mandible, near the base, being extended on each side beyond the inferior; and in some it is armed with teeth. This order includes four species, viz. vultur, falco, strix, lanius.

Order 2. The picæ have a convex, compressed bill, resembling a knife. This order contains twenty-three genera, viz. trochilus, certhia, upupa, glaucopis, buphaga, sitta, oriolus, coracias, gracula, corvus, paridisea, ramphastos, trogon, psittacus, crotophaga, picus, yunx, cuculus, bucco, boceros, alcedo, merops, todus.

Order 3. The anseres have a smooth bill, broadest at the point, covered with a smooth skin, and furnished with teeth: the tongue is fleshy; and the toes are palmated or webbed. This order includes thirteen genera, viz. anas, mergus, phaëton, plotus, rhyncops, diomedea, aptenodyta, alca, procellaria, pelecanus, larus, sterna, colymbus.

Order 4. The grallæ have a somewhat cylindrical bill: the tail is short, and the thighs are naked. This order contains twenty genera, viz. phœnicopterus, platalea, palamedea, mycteria, tantalus, ardea, corrira, recurvirostra, scolopax, tringa, fulica, parra, rallus, vaginalis, psophia, cancroma, scopus, glareola, hæmatopus, charadrius.

Order 5. The gallinæ have a convex bill: the superior mandible is vaulted over the inferior: the nostrils are half covered with a convex cartilaginous membrane: and the feet are divided, but connected at the inmost joint. This order contains ten genera, viz. struthio, didus, pavo, meleagris, penelope, crax, phasianus, numida, tetrao.

Order 6. The passeres have a conical sharp-pointed bill; and the nostrils are oval, wide, and naked. This order contains seventeen genera, viz. loxia, colius, fringilla, phytotoma, emberiza, caprimulgus, hirundo, pipra, turdus, ampelis, tanagra, mucicapa, parus, motacilla, alauda, sturnus, columba.

The generic characters of this class are taken from peculiarities in the bill, the nostrils, the tongue, the feet, the feathers, the face, the figure of the body, &c.

The characters which serve to distinguish the species are very various: for example, the colour of the particular feathers or parts of feathers; crests of feathers on the head, disposed in different manners; the colour of the cere or wax; the colour of the feet; the shape and length of the tail; the number, situation, &c. of the toes; the colour and figure of the bill, &c.

The third class, Amphibia, is divided into two orders.

Order 1. The reptiles have four feet, and breathe by the mouth. This order contains four genera, viz. testudo, draco, lacerta, rana.

Order 2. The serpentes have no legs, and breathe by the mouth. This order contains six genera, viz. crotalus, boa, coluber, anguis, amphisbæna, cæcilia.

The generic characters of this class are taken from the general figure of the body; from their having tails or no tails; being covered with a shell; having teeth or no teeth in the mouth; being furnished with lungs; having covered or naked bodies; from the number, situation, and figure of the scuta and scales; from the number and situation of the spiracula; from the situation of the mouth, &c.

The specific characters are so very various, that it would be superfluous to enumerate them.

The fourth class, Pisces, is subdivided into six orders, the characters of which are taken from the situation of the belly fins.

Order 1. The apodal have no belly fins. This order contains eight genera, viz. muræna, gymnotus, trichiurus, anarhichas, ammodytes, ophydium, stromateus, xiphias, sternoptyx, leptocephalus.

Order 2. The jugular have the belly fins placed before the pectoral fins. This order includes five genera, viz. callionymus, uranoscopus, trachinus, gadus, blennius, kurtus.

Order 3. The thoracic have the belly fins placed under the pec-

toral fins. This order comprehends nineteen genera, viz. cepola, echeneis, coryphæna, gobius, cottus, scorphæna, zeus, pleuronectes, chætodon, sparus, scarus, labrus, sciæna, perca, gasterosteus, scomber, centrogaster, mullus, trigla.

Order 4. The abdominal have the belly fins placed behind the pectoral fins. This order contains sixteen genera, viz. cobitis, amia, silurus, teuthis, loricaria, salmo, fistularia, esox, elops, argentini, atherina, mugil, exocætus, polynemus, clupea, cyprinus.

Order 5. The branchiostegous have the gills destitute of bony rays. This order contains ten genera, viz. mormyrus, ostracion, tetrodon, diodon, syngnathus, pegasus, centriscus, balistes, cyclopterus, lophius.

Order 6. The chondropterygious have cartilaginous gills. This order contains five genera, viz. accipenser, chimæra, squalus, raia, ptromyzon.

The generic characters of this class are taken from peculiarities in the head, the mouth, the teeth, the nostrils, the rays in the membrane of the gills, the eyes, the general figure of the body, the figure of the tail, the situation of the spiracula, &c.

The specific characters are taken from peculiarities in all the parts above enumerated, and many others.

The fifth class, Insecta, is subdivided into seven orders, the characters of which are taken from the wings.

Order 1. The coleopterous have four wings, the two superior ones being crustaceous, and furnished with a straight suture. This order comprehends forty-seven genera, viz. scarabæus, lucanus, dermestes, melyris, byrrhus, silpha, tritoma, hydrophilus, hister, pausus, bostrichus, anthrenus, nitidula, coccinella, curculio, brentus attelabus, erodius, staphylinus, scaurus, zygia, meloe, tenebrio, cassida, opatrum, mordella, chrysomela, horia, apalus, manticora, pimelia, gyrinus, cucujus, cryptocephalus, bruchus, ptinus, hispa, buprestis, necydalis, lampyris, cantharis, notoxus, elater, calopus, alurnus, carabus, lytta, serropalpus, cerambyx, lepturs, rhinomacer, zonitis, cicindela, dyticus, forficula.

Order 2. The hemipterous have four wings, the two superior ones being semicrustaceous and incumbent, *i. e.* the interior edges lie above one another. This order includes fourteen genera, viz. blatta, pneumora, mantis, gryllus, fulgora, cicada, notonecta, nepa, cimex, microcephalus, aphis, chermes, coccus, thrips.

Order 3. The lepidopterous have four wings, all of them imbricated with scales. This order contains three genera, viz. papilio, sphinx, phalæna.

Order 4. The neuropterous have four wings, interwoven with veins, like a piece of net-work, and no sting in the anus. This order includes seven genera, viz. libella, ephemera, hemerobius, myrmelion, phryganea, panorpa, rophidia.

Order 5. The hymenopterous have the same characters with the former, only the anus is armed with a sting. But this mark is peculiar to the females and neuters; for the males have no sting. This order comprehends fifteen genera, viz. cynips, tentredo, sirex, ichneumon, syphex, scolia, thynnus, leucospis, tiphia, chalsis, chrysis, vespa, apis, formica, mutilla.

Order 6. The dipterous have two wings, and two clavated halteres, or balances, behind each wing. This order contains twelve genera, viz. diopsis, tipula, musca, tabanus, empis, conops, oestrus, asilus, stomoxys, culex, bombylius, hippobosca.

Order 7. The apterous have no wings. This order contains fifteen genera, viz. lepisma, podura, termes, pediculus, pulex, acarus, hydrachna, aranea, phalangium, scorpio, cancer, monoculus, oniscus, scolopendra, julus.

The sixth class, Vermes, is divided into five orders.

Order 1. The intestinal are the most simple animals, being perfectly naked, and without limbs of any kind. This order contains twenty-one genera, viz. ascaris, trichocephalus, uncinaria, filaria, scolex, ligula, lingratula, strongylus, echinorhynchus, hæruca, cucullanus, caryophyllæus, fasciola, tænia, furia, gordius, hirudo, lumbricus, sipunculus, planaria.

Order 2. The molluscous are likewise simple naked animals, without any shell; but they are brachiated, or furnished with a kind of limbs. This order comprehends thirty-one genera, viz. actinia, clava, mammaria, pedicellaria, aseidia, salpa, dagysia, pterotrachea, limax, aplysia, doris, tethys, holothuria, terebella, triton, sepia, clio, lobaria, lernæ, scyllæa, glaucus, aphrodita, amphitrite, spio, nereis, nais, physsophora, medusa, lucernaria, asterias, echinus.

Order 3. The testaceous have the same characters with those of Order 2. but are covered with a shell. This order includes thirty-six genera, viz. chiton, lepas, phloas, mya, solen, tellina, cardium, mactra, donax, venus, spondylus, chama, arca, ostrea, anomia, my-

tilus, pinna, argonauta, nautilus, conus, cypræa, bulla, voluta, buccinum, strombus, murex, trochus, turbo, helix, nerita, haliotis, patella, dentalium, serpula, teredo, sabella.

Order 4. The zoophytic are compound animals, furnished with a kind of flowers, and having a vegetating root and stem. This order contains fifteen genera, viz. tubipora, madrepora, millepora, cellepora, isis, antipathos, gorgonia, alcyonium, spongia, flustra, tubularia, corralina, sertularia, pennatula, hydra.

Order 5. The infusorial consist of very small simple animals. This order contains fifteen genera, viz. brachionus, vorticella, trichoda, cercaria, leucopera, gonium, colpoda, paramecium, cyclidium, bursaria, vibrio, enchelis, bacillaria, volvox, monas.

The VERMES, or worm class, consists of animals very differently formed, of very different manners, and inhabiting very different situations. Under the Linnæan arrangement they may, in a general view be divided into such as are naked, and such as are covered with a shelly or other defensive integument. They consist, in fact, of all animals which Linnæus regarded as below the rank of insects and which he did not know how else to dispose of; and in this respect are analogous to his class of cryptogamia in botany.

The method of Cuvier, which we shall immediately subjoin, will be found a considerable improvement upon that of Linnæus in this respect. He separates the mollusca and testacea from the proper worms and the zoophytes, and arranges them into a distinct division, as we have already observed he pursues in the crustacea.

Blumenbach, as we have also remarked, chiefly differs from Cuvier, as well in this as in the preceding classes, in his subdivisions; for in the grand outlines of their arrangements the two methods may be regarded as one and the same: and we now proceed to run a parallel between them, for a comparison with the foregoing classification of Linnæus.

Animals, as indeed we have already observed, are distributed in the view of these celebrated physiologists into two grand divisions: those which have a vertebral column and red blood, and those which have no vertebræ, and are white-blooded.

In the former division there is always an interior skeleton; and a spinal marrow contained in the vertebral canal; never more than four members, of which one, or both pairs, are wanting in some instances. The brain is contained in a cranium: there is a great sym-

pathetic nerve; five senses; two moveable eyes; and three semicircular canals in the ear. The circulation is performed by one muscular ventricle at least. There are lymphatic, as well as blood-vessels. The jaws being placed horizontally, the mouth is opened by their moving from above downwards, or from before backwards. There is a continuous alimentary canal; peritoneum; liver, spleen, and pancreas, two kidneys, and renal capsules; and two testicles.

The vertebral animals are subdivided into the warm and cold-blooded.

Warm-blooded vertebral animals have both ventricles in the heart, and a double circulation; and breathe by means of lungs. The cranium is completely filled by the brain. The eyes are closed by eyelids. The tympanum of the ear is hollowed out of the cranium, and the labyrinth is excavated in the bone. Besides the semi-circular canals, there is a cochlea. The nostrils communicate with the fauces, and allow the passage of air into the lungs. The trunk is constantly furnished with ribs.

In cold-blooded vertebral animals the brain never entirely fills the cranium. The eyes seldom possess moveable eyelids. When the tympanum exists, it is on a level with the surface of the head. There is no cochlea. The different parts of the ear are connected but loosely to the cranium.

The division of warm-blooded animals contains two classes; mammalia and birds.

The mammals are viviparous, and suckle their young (from which circumstance the name is derived). They have an uterus with two cornua; and the male has a penis.

There are two occipital condyles: a very complicated brain; four ossicula auditus, and a spiral cochlea. The skin covered with hair. A muscular diaphragm separates the chest and abdomen. There is an epiglottis. The lower jaw only moves. The fluid in the lacteals is white, and passes through several congloblate glands. There is an omentum.

Blumenbach establishes the following orders in this class:

I. Bimanum. Two handed.

Genus 1. Homo.

II. Quadrumana, four handed animals: having a separate thumb, capable of being opposed to the other fingers, both in their upper

and lower extremities. Teeth like those of man, except that the cuspidati are generally longer.

1 Simiæ, apes, monkeys, baboons
2 Lemur, macauco

III. Bradypoda, slow-moving animals.

1 Bradypus, sloth
2 Myrmecophaga, ant-eater
3 Manis, scaly-lizard, or pangolin
4 Dasypus or tatu, armadillo

This order forms two in the arrangement of Cuvier. 1st, Tardigrada; which includes the sloths. There are no incisors in either jaw. There is a complicated stomach, but no rumination. 2dly, Edentata, toothless animals. Some of these have no teeth; others want the incisores and cuspidati. The tongue is long, slender, and projectile, for seizing the insects on which the animals feed; body covered with hard substances. The armadillo, manis, ant-eater, and ornithorhyncus, or duckbilled animal, belong to this order.

IV. Chetroptera, having the fingers elongated for the expansion of a membrane, which acts as a wing.

1 Vespertilio, bat.

V. Glires. Rodentia of Cuvier—gnawing animals. Have two long and very large incison teeth in each jaw, by which they cut and gnaw hard bodies, chiefly vegetables. There is a large interval behind these teeth, unoccupied by cuspidati.

1 Sciurus, squirrel
2 Glis, dormouse (Myoxus, Linn).
3 Mus, mouse and rat
4 Marmota, marmot
5 Cavia, Guinea-pig
6 Lepus, hare and rabbit
7 Jaculus, jerboa
8 Castor, beaver
9 Hystrix, porcupine

VI. Feræ, predaceous and carnivorous animals. Very strong and large pointed canine teeth: molares forming pointed prominences. Short and simple alimentary canal, and consequently slender belly.

1 Erinaceus, hedge-hog
2 Sorex, shrew
3 Talpa, mole
4 Meles, badger
5 Ursus, bear
6 Didelphis, opossum, kanguroo
7 Viverra, weasels, ferret, pole-cat, civet
8 Mustela, skunk, stoat, &c.

9 Canis, dog, wolf, jackal, fox, hyæna
10 Felis, cat, lion, tiger, leopard lynx, panther, &c.
11 Lutra, otter
12 Phoca, seal or sea-calf

The five first genera of this order form the plantigrada of Cuvier; animals which rest the whole of the foot on the ground. They are less carnivorous than the others; have a longer intestinal canal, and no cœcum.

The sixth genus forms the pedimana of the same zoologist: as they possess a separate thumb on the hind extremities only. They have a pouch in the abdomen containing the mammæ, and holding the young in their early state. One species, the kanguroo, (macropus major of Shaw) must however be excepted. That is placed among the rodentia; and does not possess the separate thumb.

The order carnivora of Cuvier will include from the 7th to the 11th genus: both inclusive. The seals belong to his amphibia.

VII. Solidungula (solipeda, Cuvier) a single toe on each foot, with an undivided hoof. Large intestines, and particularly an enormous cœcum. Incisors in both jaws.

1 Equus, horse and ass.

VIII. Pecora or Bisulca (ruminantia of Cuvier), a divided hoof. No incisores in the upper jaw. Stomach consisting of four cavities. Rumination of the food. Long intestines.

1 Camelus, camel, dromedary, lama
2 Capra, sheep, goat
3 Antilope, antelope, chamois
4 Bos, ox, buffalo
5 Giraffa, giraffe or camelopard
6 Cervus, elk, deer-kind
7 Moschus, musk

IX. Belluæ, animals of an unshapely form, and a tough and thick hide; whence they havebeen called by Cuvier, pachydermata (from παχυς, thick, and δερμα, skin). They have more than two toes: incisors in both jaws; and in some cases enormous tusks.

1 Sus, pig kind, pecari, babiroussa
2 Tapir
3 Elephas
4 Rhinoceros
5 Hippopotamus
6 Trichecus, morse or walrus, manati or seacow

The last genus of this order, together with the phoca (seals) constitutes the amphibia of Duvier. These animals have short members adapted for swimming.

X. Cetacea, whales; living entirely in the sea, and formed like fishes; breathe by an opening at the top of the head, called the blowing-hole; through which they throw out the water, which enters their mouth with the food. Smooth skin covering a thick layer of oily fat. No external ear. A complicated stomach. Multilobular kidneys, larynx of a pyramidal shape, opening towards the blowing-hole. Testes within the abdomen. Mammæ at the sides of the vulva. Bones of the anterior extremity concealed and united by the skin, so as to form a kind of fin.

1 Monodon, narwhal, sea-unicorn
2 Balæna, proper whales
3 Physeter
4 Delphinus, dolphin, porpoise

Cuvier distributes the class mammalia into three grand divisions:

1. Those which have claws or nails (*mammiféres à ongles*); including the following orders: bimana, quadrumana, cheiroptera, plantigrada, carnivora, pedimana, rodentia, edentata, tardigrada.

2. Those which have hoofs (*mammif. à ongles*); including the pachydermata, ruminantia, and solipeda.

3. Those which have extremities adapted for swimming (*mammif. à pieds en nageoire*). Amphibia and cetacea.

Birds are oviparous; have a single ovary, and oviduct; a single occipital condyle; a very large sternum; and anterior extremities adapted for flying.

They have three eyelids; no external ear; a cochlea conical, but not spiral; a single ossiculum auditus; body covered with feathers. The lungs are attached to the surface of the chest; and penetrated by the air, which goes all over the body: there is a larynx at each end of the trachea; no epiglottis. The jaws are covered with a horny substance. The chyle is transparent; no mesenteric glands; nor omentum. No bladder of urine; the ureters terminating in a bag, through which the eggs and fæces come, viz. the cloaca.

This class cannot be distributed into orders so clearly distinguished by anatomical characters as the preceding one. Blumerbach divides them into two leading divisions.

(A) Terrestrial Birds.

Order I. Accipitres, birds of prey, with strong hooked bills, and large curved talons, a membranous stomach, and short cæca.

1 Vultur, vulture tribe
2 Falco, falcon, eagle, hawk, kite
3 Strix, owl
4 Lanius, shrike or butcher bird

II. Levirostres, light-billed birds, having a large hollow bill.

1 Psittacus, parrot kind
2 Ramphastos, toucan
3 Buceros, rhinoceros birds

III. Picæ, this and the two following orders are not clearly characterised.

1 Picus, woodpecker
2 Jynx, wryneck
3 Sitta, nuthatch
4 Alceda, kingsfisher
5 Trochilus, humming birds, &c. &c.

IV. Coraces.

1 Corvus, crow, raven, jackdaw, magpie, jay, &c.
2 Coracias, roller
3 Paradisea, birds of paradise
4 Cuculus, cuckow &c. &c.

V. Passeres, small singing-birds.

1 Alauda, lark
2 Sturnus, starling
3 Turdus, thrush, blackbird
4 Eberiza, bunting
5 Fringilla, finches, canary-bird, linnet, sparrow
6 Motacilla, nightingale, red-breast, wren
7 Hirundo, swallows, martins, &c.
9 Caprimulgus, goatsucker, &c.

VI. Gallinæ, gallinaceous birds, mostly domesticated. They possess a large crop, strong muscular gizzard.

1 Columba, pigeons
2 Tetrao, grous, quail, partridge
3 Numida, guinea-fowl
4 Meleagris, turkey
5 Pavo, peacock
6 Otis, bustard

VII. Struthiones, struthious birds. The largest of the class; possess extremely small wings, and are therefore incapable of flight, but run very swiftly.

1 Struthio, ostrich
2 Casuarius, cassowary or emu

(B) Aquatic Birds.

Order I. Grallæ, waders, frequenting marshes and streams; long naked legs; long neck; cylindrical bill of different lengths.

1 Ardea, crane, stork, heron, bittern
2 Scolopax, woodcock, snipe, curlew

3 Tringa, lapwing, ruffs, and reeves
4 Charadrius, plover
5 Fulica, coot
6 Rallus, rail
7 Phænicopterus, flamingo
8 Tantalus, ibis,
&c.

II. Anseres, swimming birds; web-footed; bill broad and flat, covered by a somewhat soft substance, on which large nerves are distributed.

1 Colymbus, diver
2 Larus, gull
3 Procellaria, petrel
4 Diomedea, albatross
5 Pelecanus, pelican, cormorant
6 Anas, swan, duck, goose
7 Mergues, goosander
8 Alca, auk, puffin
9 Aptenodytes, penguin

The two classes of cold-blooded vertebral animals are the amphibia and fishes.

The former, differing considerably from each other, have very few common characters; for in different instances they walk, fly, swim, and crawl. There is no external ear, nor cochlea; the brain is always very small. The lungs are in the same cavity with the other viscera; no epiglottis, omentum, nor mesenteric glands. Two ovaries and oviducts. Cloaca, through which the fæces and urine are expelled; and in which the organs of generation terminate. Neither hair, feathers, nor mammæ.

Order I. Reptilia, having four feet, (quadrupeda ovipara).

1 Testudo, tortoise, turtle
2 Rana, frog, toad
3 Lacerta, *lizards*, crocodile, chameleon, newt, salamander, iguana, &c.

II. Serpentia. No external members; body of an elongated form, and viscera of a similar shape. They are oviparous; but the egg is sometimes hatched in the oviduct, Both jaws moveable.

1 Crotalus, rattlesnake
2 Boa. Immense serpents of India and Africa
3 Coluber, viper
4 Anguis, blind-worm
5 Amphisbæna
6 Cæcilia

Fishes—Breathe by means of branchiæ, or gills; and have no trachea, or larynx. Organs of motion consisting of fins. Nose unconnected with the organs of respiration. Ear entirely inclosed in the head; the tympanum, &c. being absent. Both jaws moveable. The place of the pancreas supplied by the pyloric cæca. An uri-

nary bladder. Two ovaries. Heart consisting of a single auricle and ventricle. They may be distributed into two leading divisions; the cartilaginous, whose skeleton consists of cartilage; the bony, where it is formed of a more firm substance.

(A) Cartilaginous Fishes.

Order I. Chondropterygii; having no gill-cover; an uterus, with two oviducts.

1 Petromyzon, lamprey
2 Gastrobranchus
3 Raia, skate, torpedo, stingray
4 Squalus, shark, saw-fish
5 Lophius, sea-devil, frog-fish
6 Balistes, file-fish
7 Chimæra

II. Branchiostegi; having a gill cover.

1 Accipenster, sturgeon, beluga
2 Ostracion, trunk-fish
3 Tetrodon
4 Diodon, porcupine-fish
5 Cyclopterus, lumpsucker
6 Centriscus
7 Syngathus, pipe-fish
8 Pegasus

(B) Bony Fishes, divided according to the situation of their fins.

Order I. Apodes; no ventral fins.

1 Muræna, eel kind
2 Gymnotus, electrical eel
3 Anarrhichas, sea-wolf
4 Xiphias, sword-fish
5 Ammodites, launce
6 Ophidium
7 Stromateus
8 Trichiurus

II. Thoracici; ventral fins directly under the thoracic.

1 Echeneis, sucking fish
2 Coryphæna, dorado
3 Zeus, dory
4 Pleuronectes, flounder, plaice, dab, holibut, sole, turbot
5 Chæladon
6 Sparus
7 Perca, perch
8 Scomber, mackarel, bonito, tunny
9 Mullus, mullet, &c. &c.

III. Abdominales; ventral fins behind the thoracic; chiefly inhabit fresh water.

1 Cobitis, loach
2 Silurus
3 Salmo, salmon, trout, smelt
4 Esox, pike
5 Clupea, herring, sprat, shad
6 Cyprinus, carp, tench, gold fish, minow, &c. &c.

IV. Jugulares; ventral fins in the front of the thoracic.

1 Gadus, hadock, cod, whiting, ling	3 Blennius, blenny
2 Uranoscopus, stargazer	4 Callionymus, dragonet
	5 Trachinus, weaver

The animals which have no vertebral column do not possess so many common characters as the vertebral classes. Their hard parts, when they have any, are generally placed on the surface of the body. The centre of the nervous system, instead of being inclosed in a bony case, lies in the same cavity with the viscera. The œsophagus is generally surrounded by a nervous chord coming from the brain. Their respiration is not carried on by lungs; and they have no voice. Their jaws move in various directions. They have no urinary secretion.

The invertebral animals were distributed by Linnæus into two classes; insects and worms, (vermes). The anatomical structure of these animals was very imperfectly known, when the Swedish naturalist first promulgated his arrangement. But the labours of subsequent zoologists, and particularly those of Cuvier, have succeeded in establishing such striking and important differences in their formation, that a subdivision of the Linnæan classes became indispensably necessary. The insects of Linnæus are divided into crustacea and insecta: and the vermes of the same author form three classes; viz. mollusca, vermes, and zoophyta.

The mollusca derive their name from the soft fleshy nature of their body. This class includes those pulpy animals, which may either be destitute of an external covering, when they are called mollusca nuda, as the slug; or may be enclosed in one or more shells, as the snail, oyster, &c. when they are termed testacea.

The animals of this class have no articulated members; they have blood-vessels, and a true circulation. They respire by means of gills. They have a distinct brain, giving origin to nerves; and a spinal marrow.

1 Sepia, cuttle-fish	7 Clyo
2 Argonauta	8 Patella, limpet
3 Nautilus	9 Helix, snail
4 Limax, slug	10 Haliotis, Venus's ear
5 Aplysia	11 Murex, caltrop, or rock-shell
6 Doris	12 Strombus, screw

13 Buccinum, whelk
14 Ascidia
15 Thalia
16 Ostrea, oyster
17 Solen, razor-shell
18 Cardium, cockle
19 Mytilus, muscle,
&c. &c.

Cuvier classes the numerous genera of this order under the three following divisions; 1st, cephalopoda, (from κεφαλη, the head, and πες, the foot) which have the organs of motion placed round the head: 2dly, gasterapoda, (from γαστηρ, the belly, and πους) such as crawl on the belly: and 3dly, acephela, (from α, privative, and κεφαλη), which have no head. The three first genera belong to the first division, the ten succeeding ones come under the second; and the remainder exemplify the last order.

According as the shell of the testaceous mollusca consists of a single convoluted tube; or of two, or more, separate pieces; they are called cochleæ bivalves, multivalves, &c.

Crustacea possess a hard external covering, and numerous articulated members. A long nervous chord, beset with ganglia. Compound eyes. Antennæ and palpi like those of insects. A heart and circulating vessels; and gills. Teeth in the cavity of the stomach.

1 Cancer, crab, lobster, cray-fish, shrimp
2 Monoculus

Insects have articulated members and antennæ. Those which fly are subject to what is called a metamorphosis; they pass through certain intermediate states of existence, before they assume the last, or perfect form. From the egg proceeds the larva, or caterpillar; this changes to the chrysalis, nympha, or aurelia; from which the perfect insect is produced. Nervous system consisting of a chord beset with ganglia. No heart nor blood-vessels. Respiration carried on by means of tracheæ.

Order I. Coleoptera; having a hollow horny case, under which the wings are folded.

1 Scarabæus, beetles
2 Lucanus, stag-beetle
3 Dermestes
4 Coccinella, ladybird
5 Curculia, weevil
6 Lampyris, glow-worm
7 Meloe, Spanish-fly
8 Staphylinus
9 Forsicula, ear-wig

II. Hemiptera; four wings, either stretched straight out, or resting across each other.

1 Blatta, cock-roach	3 Fulgora, lantern-fly
2 Gryllus, locust, grasshopper	4 Cimex, bug, &c. &c.

III. Lepidoptera; soft hairy body, and four expanded wings.

1 Papillo, butterfly
2 Sphinx, } moths
3 Phalæna, } moths

IV. Neuroptera; four reticulated wings.

1 Libellula, dragon-fly	2 Ephemera, &c.

V. Hymenoptera; generally possessing a sting.

1 Vespa, wasp, hornet	4 Termes, white ant
2 Apis, bee	5 Ichneumon,
3 Formica, ant	&c.

VI. Diptera; two wings.

1 Œstrus, gad-fly	3 Culex, gnat, mosquito
2 Musca, common flies	4 Hippobosca, horse-leech, &c.

VII. Aptera; no wings.

1 Podura, spring-tail	4 Acarus, tick, mite
2 Pediculus, louse	5 Aranea, spider
3 Pulex, flea, chigger	6 Scorpio, scorpion, &c.

The vermes may be divided into two orders; the intestinal, which inhabit the bodies of other animals; and the external.

The former are not of such a complicated organization as the latter; so that they are sometimes arranged among the zoophytes. The external worms have a nervous chord possessing ganglia; an elongated body composed of rings; and have no distinct head. There are no members. Circulating vessels, but no heart. No nerves have been discovered in the intestinal worms.

Order I. Intestini.

1 Gordius, guinea-worm	4 Fascioli, fluke
2 Ascaris, thread-worm, round-worm	5 Tænia, tape-worm
3 Tricocephalus	6 Hydatis, hydatid

II. Externi.

1 Aphrodite, sea-mouse	5 Nais
2 Sipunculus	6 Planaria
3 Hirudo, leech	7 Lumbricus, earth-worm,
4 Nereis	&c.

The Zoophytes have neither brain nor nerves; no heart, nor, perhaps, blood-vessels; no articulated members.

Order I. Echinodermata; covered by a hard and tough coriaceous skin.

1 Echinus, sea hedgehog	2 Asterias, star-fish, &c.

II. Soft or Gelatinous Zoophytes.

1 Medusa, sea-blubber, sea-nettles	2 Actinia, sea-anemony
	3 Hydra, fresh-water polype

III. Infusoria; the animalcules of infusions.

1 Vorticella, wheel-animal	4 Volvox
2 Brachionos	5 Monas
3 Vibrio, eel of vinegar	

IV. Inhabitants of corals, corallines, sponges, &c.

The coral reefs that surround many islands, particularly those in the Indian Archipelago, and round New Holland, are produced by various tribes of these animals, particularly by the cellepora, isis, madrepora, milepora, and tubipora. The animals form these corals with such rapidity, that enormous masses of them very speedily appear where there were scarcely any marks of such reefs before.

[*Pantologia.*

CHAP. II.

WORMS.

Vermes.—LINN.

SECTION I.

Introductory Remarks.

THE system of zoology that still continues most popular in our own country is that of Linnæus, and we shall hence make choice of it in the prosecution of the present work. Under this system the various classes of animals which it comprises may be contemplated in an ascending or a descending scale. Having commenced with inorganic matter, and meaning to close with the mechanical and other curious inventions of human intellect, we shall prefer the former of these views; and shall open with a few specimens of the lowest of the Linnæan classes, and which he has distinguished by the name of *Vermes*, or the *Worm Tribes*, the classific and ordinal characters of which we have already stated in the preceding chapter.

[EDITOR.

SECTION II.

Infusory Worms or Animalcules; Wheel-animal, Eel-vibrio, Trichoda, Monas.

THESE constitute a division of animals which until the latter part of the 17th century, had escaped all human attention and investigation, and constituted a kind of invisible world: a series of beings, the structure, powers, and properties of which, are perhaps more astonishing than those of most other animals: yet of such minute-

ness as, in general, to elude the sharpest sight, unless assisted by glasses. The ancients therefore were totally unacquainted with this class of beings. To them the mite was made the *ne plus ultra*, or utmost bound of animal minuteness; but the moderns, assisted by the invention of the microscope, have discovered whole tribes of animals, compared to which even mites may be considered as a kind of elephants. These minute beings are chiefly to be observed in fluids of various kinds; and principally in such as have had any animal or vegetable substances infused in them; and for this reason they are often called in modern zoology, by the title of *animalcula infusoria*, or infusorial animalcules. A most extraordinary idea was entertained by the celebrated Count de Buffon, relative to these animalcules; viz. that they were not real animals, but a kind of organic particles or moleculæ, which were capable, under certain circumstances, of being formed into animated beings. The experiments of Spallanzani and others have, however, completely overthrown this chimerical and absurd theory of the Count de Buffon; and indeed one would hardly think it possible for any person of unprejudiced mind, nay one may even add, of common sense, to view the several animalcules in fluids, and at the same time to doubt of their being real animals. Their rapid and various motions; their pursuit of the smaller kinds on which many of the larger prey; their avoiding each other as they swim; the curious and regular structure of their bodies; and their whole appearance, form the most convincing proofs of their real animal nature and life.

Animalcules, as before observed, are most frequently found in fluids; but this is a doctrine that has not always been clearly understood, and has been productive of some erroneous ideas in natural history. Some writers, for instance, have asserted that almost every kind of fluid abounded with animalcules; and that wines and spirits exhibited legions of them. This, however, is so very far from the truth, that none are ever to be discovered in inflammable spirits, or in any fermented liquor that has not passed either into the state of vinegar, or that is not grown completely vapid. As almost all extraordinary discoveries are liable, when related by unskilful persons, to have their circumstances exaggerated by additional ornaments, we need not be surprized that this has been the case relative to the history of microscopic animalcules. No sooner did the microscopical observations of Leewenhoeck and a few others

become pretty generally known, than immediately, as if by a kind of fatality, the animalcular doctrine was carried a great deal too far; and innumerable substances were supposed to swarm with these minute beings, which later and more accurate observations have proved to be totally free from them. Thus, the blueish or bloomy appearance on the surface of several sorts of plumbs, grapes, and many other fruits, has been supposed owing to innumerable legions of animalcules on the surface of the fruit: but this idea is entirely erroneous. It happens, a little unfortunately, that Mr. Pope has introduced it into his celebrated poem, the Essay on Man, which still continues to propagate the mistake amongst those who are not scientifically conversant in such subjects.

> " Ev'n the blue down the purple plum surrounds,
> " A living world, thy failing sight confounds."

The blueish appearance above-mentioned is a mere vegetable efflorescence, which regularly takes place on such kind of fruit, and consists of particles of no determined shape, and has not the least appearance that could lead to a supposition of its being of an animal nature.

To attempt a methodical enumeration of animalcules appears, at first view, almost a hopeless labour; since exclusive of the vast variety of species, (of which, in all probability, only a small part has yet been observed), many of them have a power of changing their shape at pleasure; so as to appear widely different at particular times from what they did the moment before; and others, though their form is constant, are apt to vary in colour; by which means some deception or obscurity may arise, and an uncertainty in determining the species. Much, however, has been done: a great many species of animalcules have been perfectly well described, and are perfectly well known to microscopical observers, since they possess characters too clear and plain to admit of any doubt of their species, whenever they happen to appear.

As examples of this curious and interesting race of animals, we shall particularize a few of the most remarkable kinds, and such as are well figured in the works of naturalists.

Among these the genus called vorticella is one of the principal. Its character is, that the mouth or opening is surrounded by nume-

rous short feelers, forming a kind of fringe round the head. One of the most elegant species of vorticella is the vorticella convallaria, a beautiful transparent animalcule, the body of which is formed like a bell-shaped flower, and is furnished with a very long tail or stem, by which it affixes itself to whatever substance it pleases. When a groupe of these animalcules is viewed by the microscope, it exhibits the appearance of a set of animated flowers, alternately stretching out their stems at full length, and again suddenly contracting them in a spiral twist. This species is very common, and is generally found attached to the stems and under surface of the leaves of the common lemna minor, or duckweed.

But a still more elegant species is the vorticella racemosa. It is found during the summer months in clear stagnant waters, attached to the stalks of the smaller water plants, and other objects; to the naked eye the whole groupe, on account of the great number of individuals composing it, is distinctly visible, in the form of a small whitish spot, resembling a kind of slime or mouldiness, but when placed under the microscope in a drop of water on a glass, its extraordinary structure is immediately perceived. From a single stem proceed, at various distances, several smaller ramifications, each terminating by an apparent flower, like that of a convolvulous, and furnished on the opposite edges, with a pair of filaments resembling stamina. The whole is in the highest degree transparent, and perfectly resembles the finest glass; while the varying motions of the seeming flowers, expanding and contracting occasionally, and turning themselves in different directions, afford a scene so singularly curious, as to be numbered among the finest spectacles which the microscope is capable of exhibiting. Each animal, though seated on the common stem, is complete in itself, and possesses the power of detaching itself from the stem, and forming a fresh colony from itself.

To the genus vorticella also belongs the celebrated animalcule called the wheel-animal, from the appearance which the head in some particular positions exhibits; as if furnished with a pair of toothed wheels, in rapid motion: this animalcule, which is called vorticella rotatoria, has long ago been pretty well described and figured by Baker, in his work on the microscope: it is of a lengthened shape, and of a pale brown colour, and is of such a size as to be sometimes perceptible by a sharp eye, even without a glass. It

is remarkable for its strange power of reviviscence, or restoration to life and motion, after being dried for many months on a glass. The wheel-animal is often found on the scum covering the surface of stagnant waters, but more frequently in the water found in the hollows of decayed trees after rain.

In spring and summer, nothing is more common than to see the surface of the smaller kind of stagnant waters covered with a fine deep-green scum; and frequently the same kind of greenness is diffused throughout the whole body of the water: this green colour is entirely owing to an animalcule of a genus called cercaria*. It has of late been described under the name of cercaria mutabilis, or changeable cercaria, because a variety sometimes occurs of a red colour. The animal is of a lengthened oval shape, with a slightly lengthened tail, the body or middle part appearing as if filled with very numerous green spawn or ova, while the extremities are transparent. It occurs at this season of the year in almost every puddle. The red variety is far less common, and the appearance which it exhibits is such as to alarm the superstitious with the idea of the water being changed into blood; a panic of which numerous instances have been adduced by authors; and which is the more excusable in those who are ignorant of the cause, as the animalcules are so very small as to be utterly imperceptible, except to an uncommonly acute eye, without the assistance of the microscope; so that even taking up, and examining it, affords no satisfactory elucidation to the vulgar. Not unfrequently we have seen the whole surface of a large pond thus covered with this animalcule, of which there was not the least appearance the preceding day. It should be observed that some other animals, and particularly some small insects of the genus monoculus, have occasionally produced a similar appearance: but in that case the demonstration becomes easy; since every one, on taking up the water, perceives the red insects. We are assured by Swammerdam, that the whole city of Leyden was one morning in a state of consternation, on discovering that the waters of that place were apparently changed into blood; but the philosopher soon had the satisfaction of undeceiving the people, by demonstrating to them the real cause.

Among the most remarkable of the animalcular tribe may be

* Naturalist's Miscellany, vol. iii. pl. 107.

numbered a species of the genus called Trichoda, chiefly characterized by being beset with hairs or filaments. The species I have just mentioned is the Trichoda Sol; so named from its presenting the appearance of a sun, as generally expressed in engraving; viz. a globe or ball, beset on all sides with very long diverging rays, or spines. This animalcule is of a remarkable inactive nature, affixing itself to the stem of some small water plant, and occasionally moving at the rate of about a quarter of an inch in an hour. Its size may be considered as gigantic, for one of the animalcular tribe, being equal to that of a small pin's head. This animalcule may be pulled or torn in pieces, by means of a pair of needles or other convenient instruments, and in the space of a single hour each piece will be apparently complete, and perfectly globular like the original. It prays on small Monoculi, particularly on a very small species called by Linnæus Monoculus Pediculus, hardly larger than a grain of sand. The Trichoda Sol appears to have been first described by a German author of the name of Eickhorn, and afterwards more fully by Müller.

The genus called Volvox also presents one of the largest and most curious of Animalcules, as well as one of the most beautiful, the chief species, or Volvox Globator, often equalling the size of a pin's head. In the advanced state of spring, and again in autumn, it appears in immense numbers in the clearer kind of stagnant waters. Its general colour is green; but it sometimes is of a pale orange-colour. Its motions are irregular, in all directions, and at the same time rolling or spinning as if on an axis. When microscopically examined it presents one of the most curious phænomena in natural history, being always pregnant with several smaller animals of its own kind, and these with others still smaller: the whole external surface is covered with very numerous small tubercles; which some have supposed to act as a kind of fins, while others have supposed them to be the valves of so many orifices which the creature can either open or close at pleasure, in order to manage its various motions. When groupes of these beautiful animalcules are viewed by the solar microscope, they strongly recal to the recollection of the spectator the magnificent scene in Mr. Walker's Eidouranion, representing numerous worlds revolving in various directions.

In a genus called Vibrio, from its vibrating or serpentine form and motion, we meet with the largest of all the animalcular tribe,

viz. the Vibrio Anguillula or Eel-Vibrio, of which one variety inhabits acid paste made of flower and water, or such as is used for the common purposes of bookbinding; and the other variety is often found in common vinegar. The paste Vibrio is distinctly visible to a good eye without a glass, and when full grown measures the tenth of an inch in length; it is viviparous, and frequently produces a tribe of young. Its general appearance when magnified is that of an eel. This animalcule, from its size, and the ease with which it may at all times be kept and observed, is peculiarly interesting. It generally swarms on the surface of the paste, and often coats the sides of the vessel in which it is kept, often forming a kind of ramifications, resembling the branched appearance of frost on a window: this is particularly observable in rainy weather.

The genus Cyclidium is distinguished by its oval shape, and is among the smallest of animalcules: the common oval Cyclidium never fails to appear in countless swarms in any kind of vegetable infusion after the space of a few days; as in infusions of hay, beans, wheat, and other substances. Its motions are generally very rapid.

The smallest of all the animalcular tribe belong to a genus called Monas: its character is an oval or roundish body, with a central point or speck. Whenever any kind of soft vegetable substance has been either infused or boiled in water, the water, when set by, will not fail to exhibit animalcules of this genus, sometimes in the space of twelve, but assuredly in the space of twenty-four hours afterwards. The smallest of all these, and the smallest of all animal beings, as far as human research is capable of discovering, is a species called Monas Termo, which when surveyed by the utmost powers of the microscope, still appears but as a kind of moving point, having merely a sensible diameter. It is found in various vegetable infusions, appearing in the space of a few hours.

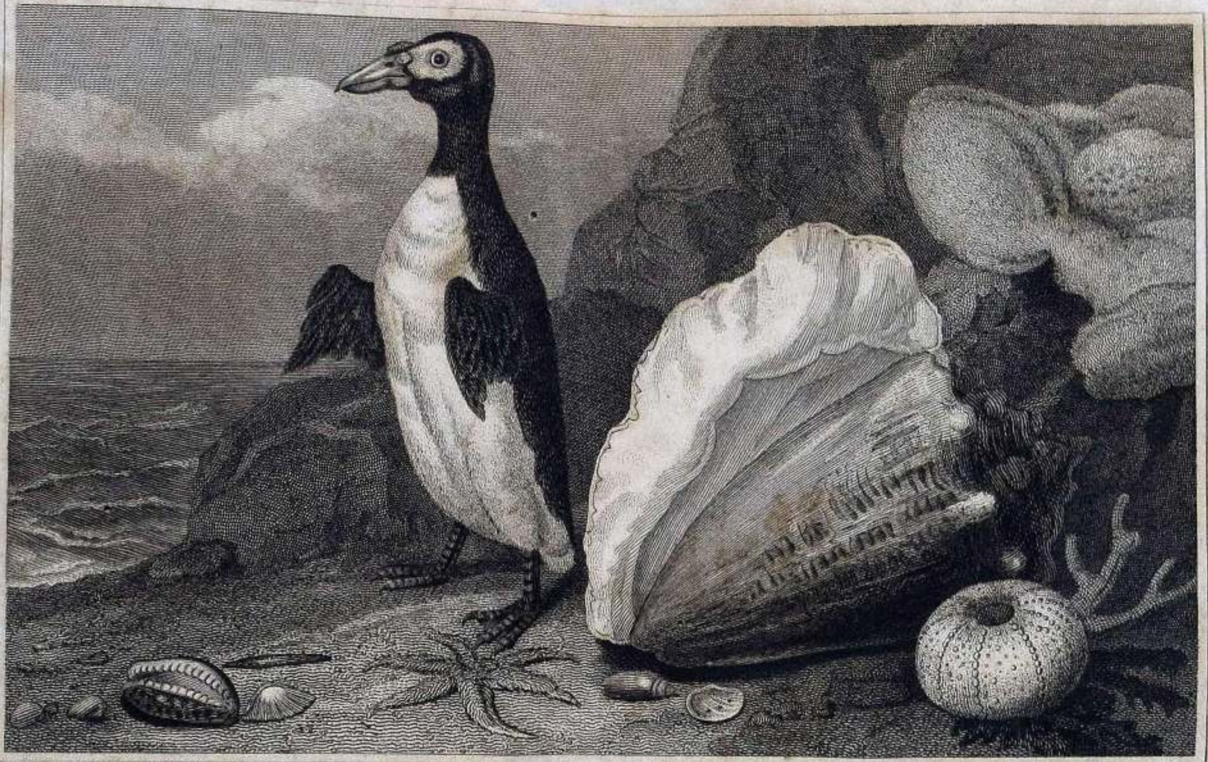
[*Shaw.*

SECTION II.

Zoophytes, or Zoophytic-worms; Polypes; Corals; and Sponges.

ZOOPHYTES, or Plant-animals, are so denominated from their existing in the shape of plants. Of these the genus Hydra, or Polype, deserves our first attention; not only from its wonderful nature and properties, but because it serves as a kind of standard or example of reference in many other genera of zoophytes more or less allied to it.

The genus hydra or polype, comprehending the real or fresh-water polypes, was so named by Linnæus because in reality it affords phænomena similar to those recorded of the fabulous hydra of antiquity, which, when one head is cut off, produced others in its place. The character of the hydra, or polype, is a long, tubular body, possessing a great power of contraction and extension; affixing itself by the tail; and furnished at its upper or open end with a certain number of long arms, or tentacula, differing in number in the different species. The principal species are the brown, the yellowish-grey, and the green polypes, or the hydra fusca, grisea, and viridis, of Linnæus. These curious animals may be found in small streams and in stagnant waters, adhering to the stems of aquatic plants, or to the under surfaces of the leaves, and other objects. They prey on small worms, monoculi, and many other animals which happen to occur in the same waters. If a polype be cut in two, the superior part will produce a new tail, and the inferior part will produce a new head and arms; and this, in warm weather, in the course of a very few days. If cut into three pieces, the middle portion will produce both the head and tail; and in short, polypes may be cut in all directions, and will still reproduce the deficient organs. The natural mode of propagation in this animal, is by shoots or offsets, in the manner of a plant: one or more branches or shoots proceeding from the parent stem, and dropping off when complete; and it frequently happens that these young branches will produce other branches before they themselves drop off from the parent; so that a polype may be found with several of its descendants still adhering



Engraved by Lacey, from a Drawing by Craig. For the Gallery of Nature & Art.

THE PENGUIN, WITH THE CONC, AND OTHER SHELLS, SPONGES, &c.

to its stem; thus constituting a real genealogical tree: but the polype also, during the autumnal season, deposits eggs, which evolve themselves afterwards into distinct animals, and thus it possesses two modes of multiplication. It appears a paradoxical circumstance, that a polype should be able to swallow a worm three or four times as large as itself, which is frequently observed to be the case; but it must be considered that the body of the animal is extremely extensile; and that it possesses the power of stretching according to the size of the substance which it swallows. It seizes its prey with great eagerness, but swallows it slowly, in the same manner as a snake swallows any small quadruped. The arms of a polype, when microscopically examined, are found to bear a general resemblance to those of the sepiæ, or cuttle-fishes, being furnished with a vast number of small organs, which seem to act as so many suckers, or acetabula, by which means the animal can hold a worm, even though but slightly in contact with one of its arms; but when on the point of swallowing its prey, it then makes use of all the arms at once, in order the more readily to absorb it.

The number of zoophytes is extremely great, and the major part are of an appearance so much resembling vegetables, that they have been generally considered as such; though the horny and stony appearance of several of the tribe, at first view, declare them to be of a widely different nature from the generality of plants. In others, however, the softness of their substance, and their ramified manner of growth, would immediately lead any one unacquainted with their real nature, to suppose them vegetables. The hard, horny, or stony zoophytes, are in general known by the name of corals; and of these there are several genera, or kinds, instituted from the structure and appearance of the coral or hard part, and the affinity which the animal or softer part bears to some other genus among the soft-bodied animals or mollusca. The zoophytes therefore unite the animal and vegetable kingdoms, and fill up the intermediate space.

By the ancients, most of the zoophytes were considered as plants; but in later times, some philosophers have imagined them rather to belong to the mineral kingdom, fancying that they grew or increased somewhat in the manner of crystals, and other regularly figured bodies.

About the beginning of the eighteenth century, some observations were made on the common red coral, and some other species,

by Count Marsigli, which seemed to prove them of a vegetable nature; for on gathering them perfectly fresh, and placing them in sea water, they appeared to put forth small flowers from all the minute cavities, or hollow points on the surface. These, therefore, were considered as a convincing proof that coral was a plant. The arguments against this theory were, the animal odour which they diffused in burning, and a greater degree of sensibility in the supposed flowers than seemed quite consistent with the generality of plants.

A very few years after Count Marsigli's discovery and description of the supposed flowers of coral, Dr. Peysonel, a French physician, from observations made on some parts of the European coasts, as well as on those of the West Indies, ventured to propose to the French Academy, a new theory relative to the nature of corals; in which he maintained, that the supposed flowers were real animals, allied to actiniæ; and that, in consequence, the corals should be considered as aggregates of animals, either forming, or at least inhabiting the calcareous substance of the coral in which they appeared.

To this theory no great attention was paid; and several years elapsed before a farther advance was made in the knowledge of these bodies: but at length, about the year 1730, a Mr. Trembly, of Geneva, in searching after some small aquatic plants, happened to discover the animals now called polypes: these had indeed been discovered long before by Leewenhoeck, in Holland; but he only gave a general description of the animal, and observed that it multiplied by an apparent vegetation, but was ignorant of its power of reproduction after cutting: but Mr. Trembly, surprised at the singular appearance of a creature which had at once the aspect of a plant, and the motions of an animal, determined to try the experiment of cutting it, in order to ascertain its doubtful nature; and was beyond measure astonished to find that instead of destroying it, both parts seemed uninjured by the wound, and that in a very few days each had reproduced every limb that had been lost, and eat, and moved as before. This discovery being announced, was at first considered by many as a fable; and it was even contended, that this division of animal life was in itself absolutely impossible, upon the principles of common sense, as well as of sound philosophy: but at length, the attention of all Europe being excited by the singularity of the circumstance, the animals were every where sought after, and experiments made by cutting them in every possible direction, and their

real nature thus completely ascertained; and from subsequent observations it was found that the animals of most of the coral tribes, both hard and soft, were strongly allied to polypes, and were endowed with the same re-productive properties; while others were possessed of the same power, but seemed more allied to the actiniæ, or sea-anemonies, and to the medusæ, or sea-blubbers. Afterwards the celebrated Mr. Ellis, by repeated observations made about the British coasts, proved beyond all doubt, that the smaller corals, commonly known by the name of coralines, or sea-mosses, were actually so many ramified sea-polypes, covered with a kind of strong, horny case, to defend them from the injuries to which they would otherwise be liable, in the boisterous element in which they are destined to reside.

Mr. Ellis's observations on the harder, or stony corals, as well as the observations of many other philosophers, have at length proved also that these stony corals are equally of an animal nature; the whole coral continuing to grow as an animal, and to form by secretion, the strong or horny part of the coral, which at once may be considered as its bone and its habitation, which it has no power of leaving, and a coral of this kind is therefore a large compound zoophyte.

[*Shaw.*

Sponges afford us another curious proof of zoophytic life; each of which is characterised in the Linnæan system as a fixed animal, flexile, torpid, of various forms, composed either of reticulate fibres, or masses of small spines interwoven together, and clothed with a gelatinous flesh, full of small mouths on its surface, by which it absorbs and rejects water.

After having been regarded at different periods as an organized living substance, of a doubtful kind; then as an inorganized substance; then as a vegetable; sponge is now advanced to the animal kingdom, and usually classed as we have arranged it above. So early as the days of Aristotle, it was noticed by the persons employed in collecting it, to shrink back when torn from the rocks, and was hence supposed to be in some way or other possessed of animal sensation: and this opinion, prevalent in the time of Aristotle, was still prevalent in that of Pliny.—For many ages afterwards, however, these naturalists appear to have been regarded as mistaken upon this

subject, and sponges were again held to be altogether insentient substances. Marsigli first, in modern times, declared them to be entitled to the rank of vegetables; and Dr. Peysonell, towards the middle of the last century, sent two papers upon this subject to the Royal Society, both which are printed in its Transactions, in which he maintained that they were not vegetables, but animals; and pointed out what he conceived to be the mode of their growth and propagation. The idea had, indeed, been occasionally indulged for nearly half a century antecedently; but it was conceived too romantic and visionary for general adoption: and hence all the natural histories published at this period concur in the theory of Marsigli, and Bauhine, Lobel, Tournefort, Hill, and all the celebrated botanists of the day, give them free admission into the vegetable kingdom, and describe them as submarine plants. Ellis, however, seems to have settled the point in 1762: his observations and experiments were chiefly made upon the spongia tomentosa; he satisfactorily ascertained the existence of the animal inhabitant; remarked its contraction within its cells when exposed to pain or injury; the expiration and inspiration of water through its tubes; and established the position that sponge is an animal; and that the ends or openings of the branched tubes are the mouths by which it receives its nourishment and discharges its excrement: a position which chemistry has since abundantly supported by proving the ammoniacal property of the cellular matter of sponge.

There are forty-nine species of this zoophyte, of which the chief, denominated from their shape or places of residence, are common sponge; downy sponge; grape sponge; lake and river sponge; coxcomb sponge.

[*Pantologia.*

SECTION IV.

Molluscous Worms, or those without Shells.

ONE of the simplest specimens we can refer to belonging to this class, is the slug or limax. Among the more curious we may mention the following.

1. *Sepia, Cuttle, or Ink-fish.*

This is one of the most extraordinary of the entire order. The

cuttle-fish is distinguished by having a fleshy and somewhat lengthened body, seated or enveloped in a kind of sheath, reaching nearly to the head of the animal. The head is furnished with very large eyes, and a horny, central beak, consisting of two mandibles, and resembling that of a parrot. Round the base of the head arise eight long arms, in a radiated direction, and in some species are two additional arms, of a much greater length than the rest. All these arms are beset, on their internal surface, with numerous, round, concave cups, or suckers, which adhere so strongly to whatever substance the animal chuses to attach itself to, as not to be separated without great force.

Exclusive of these characters, the animals of this genus are furnished with an internal pouch or receptacle, filled with a very dark-coloured fluid, in some species intensely black: this fluid they discharge at pleasure through a tubular orifice situated at the base of the breast.

The most common European species of this genus is the *Sepia Officinalis* of Linnæus, generally known by the name of the *Cuttle-fish*. This animal, which, at its full growth, measures about two feet in length, is of a pale bluish-brown colour, with the skin marked by numerous dark-purple specks. Imbedded in the back or fleshy part of the body of this species is always found a large oblong-oval, calcareous bone, of a cellular texture, and which is of so light a nature as to float in water. It has been supposed that the animal has the power of filling the minute cellules of this bone with air, or of exhausting them of it at pleasure, in order to ascend or descend with the greater facility. This bone of the cuttle-fish is often found in considerable quantities, cast on the shores, and forms a small article of commerce, being used for various purposes by different artificers. It also serves, when reduced to powder, as a good common dentifrice, and is indeed considered as one of the most innocent that can be used for that purpose.

The anatomy of the cuttle-fish is highly curious, and has long ago been detailed by Swammerdam and others; and was even not unknown to the ancients. The animal is furnished with a pair of large lungs, or respiratory organs, situated nearly as in quadrupeds, but they are constituted on a different principle, and are more allied to the gills of fishes. The most striking particularity however in this animal, is that of having three distinct hearts: these are situated

in the form of a triangle, and the lowest of the three is larger than the rest. The eyes, which in this whole genus are remarkably large, are covered, as in eels and some other fishes, by the common skin, which is transparent in those parts. The pupil of the eye appears double, and the internal cavity of the eye is lined with a purplish-coloured mucus, which causes the eyes of the living animal to appear phosphoric, or fiery, in a high degree: the exterior coat or ball of the eye is remarkably strong, so as to seem almost calcareous, and is, when taken out, of a brilliant pearl-colour; and they are worn in some particular parts of Italy, and in the Grecian islands, by way of artificial pearls in necklaces. The cuttle-fish, like the rest of its tribe, is of a predacious nature, and feeds on fishes, shell-fish, and other marine animals, and is, no doubt, a highly formidable adversary; since it possesses the power of fastening itself so closely by the assistance of the suckers or cups of its arms, that no animal, unless of very considerable size and strength, can be supposed to liberate itself from its grasp. Its favourite residence is between the vacuities or clefts of submarine rocks, where it is generally sure of meeting with plenty of food; and, in defect of which, in such situations, it occasionally sallies out into the ocean in pursuit of prey. During these excursions, on the approach either of danger to itself, or the more easily to prevent the escape of its intended prey, it discharges, from the tubular orifice at the breast, a quantity of the black fluid, with which it is always amply provided; and thus obscures or darkens the water to a great distance round. This practice of the cuttle-fish was well known to the ancients. Our own celebrated countryman, Mr. Ray, draws from this circumstance a singularly apposite and witty illustration; and observes that an obscure and prolix author may not improperly be compared to a cuttle-fish, since he may be said to hide himself under his own ink! The black liquor or ink of the cuttle-fish, when collected, and dried, splits or cracks into fragments, which being then ground down, and redissolved in water, form an exquisite ink, of the most durable blackness; and the well-known Chinese preparation, commonly called Indian-ink, is, in reality, supposed to be no other than the concrete juice of the cuttle-fish, carefully managed, perfumed, and at length formed into the ornamented cakes or masses in which we receive it. I should here observe that all the species of the genus sepia are provided with a similar fluid, which they use for similar

purposes; but that of the common cuttle-fish is of a de r or blacker colour than in most other kinds. In some species s of a reddish-brown colour; and from it is prepared, by the C se, the brown and reddish brown varieties of Indian-ink which e sometimes seen. The ancient Romans, as appears from seve passages in their writings, made use of the juice of the cuttle-f by way of an ink; but they seem to have been unacquainted h any other mode of preparing it, than that of merely mixing or ssolving it in water. The female cuttle-fish deposits its eggs i umerous clusters, on the stalks of fuci, on corals, about the jecting sides of rocks, or on any other convenient substances. ese eggs, which are of the size of small filberds, and of a bla colour, are popularly known by the name of sea grapes: each i vidual egg is of an oval shape, but with a somewhat sharpened p nt; the young proceeds from it complete in all its parts, and d ering from the parent animal in no other respect than that of size.

The calamary, loligo, pen-fish, or smaller ink-fish, is a species scarcely less formidable than the preceding. I is of a much more lengthened shape, of a dark colour, and with e two long additional arms of greater length in proportion; and o each side the tail is an expansion or process, forming a kind of ort triangular fin. This animal is also an inhabitant of the Europ n seas, but is less common than the cuttle-fish. It has the same abit of occasionally darkening the water by the discharge of its i . Instead of the remarkable calcareous bone belonging to the c mmon cuttle fish, we find in the calamary a long, thin, transparent pen-shaped cartilage, of a curious appearance, pointed at the tip f the dilated part, and semicylindrical at the other end, some hat representing the stem of a quill. This is supposed to be the reason of the name of calamary, applied to this species. Its genera habits are very similar to those of the cuttle-fish. It is a very prolific animal, and the eggs are of a very singular and curious appearance: they are deposited in the form of numerous lengthened groups, radiating from a common centre, and spreading every way into a circular form: each egg is of a glassy transparency, and the young animal may be very distinctly observed in each, many days before the period of exclusion. These groups of the eggs of the calamary are often seen swimming on the surface, and are occasionally thrown on shore; the groupe sometimes mea-

sure more than a foot in diameter, and from its general appearance, unless closely inspected, is often mistaken for a species of medusa, or sea-blubber.

A more remarkable species than either of the preceding, is the eight-armed cuttle-fish, or sepia octopodia of Linnæus. This animal has a short, oval body, surrounded at the upper part by an expansile membrane, into the sides of which are inserted the arms; which are of great length, beset on the inside with a double row of suckers or holders, and are all of equal length, or without an additional long pair as in the two preceding species of this genus. The eight-armed cuttle-fish, when at full growth, may be considered as a very formidable animal, and possesses such a degree of strength as to make it dangerous to attack it without great precaution. Such is the ferocity and violence with which it defends itself, that even the strongest mastiff can hardly subdue it without a long and doubtful contest. It has even been known to attack a person while swimming, and to fasten itself with dangerous force round the body and limbs. It is supposed that there is something more than a mere power of adhesion in the acetabula, or concave suckers or fasteners with which the arms of this animal are beset; something of an electric or galvanic nature; since the pain which their application causes does not soon cease after the removal of the animal; a kind of stinging or urtication remaining for many hours; and long after this, a troublesome irritation and itching.

This species arrives at a very large size, being often seen so large that the body equals the size of a gourd, while the arms measure from three to four feet in length, and from nine to twelve in circumference, when spread out in the form of a star, which is a posture in which the animal frequently places them. It resides in the deep channels formed by large rocks, and is generally seen in pairs. The male is said to wander about in quest of prey to a certain distance from its recess, while the female rarely wanders from it. The eggs of the eight-armed cuttle-fish are extremely numerous, and are disposed in a kind of grape-like cluster: they are of a glassy transparency, so that the young animal, as in those of the calamary, may be seen in them long before the time of its exclusion.

The sepiæ or cuttle-fishes in general, were often called by the ancients by the title of polypi, on account of their numerous limbs:

they also possess, like the polypi of modern natural history, a considerable degree of reproductive power; being often seen with limbs which have evidently been mutilated, and have reproduced.

The eight-armed and common cuttle-fish are numbered among the edible marine animals, and are still used in many parts of Europe as a food. With the Romans they seem to have been considered as a delicacy. When boiled, they assume a red or deep salmon-colour, especially when salted. The Greeks, as well as the Romans, are known to have been in the habit of using the cuttle as a food; and it has been supposed, and surely not without a considerable degree of probability, that the celebrated plain, but wholesome dish, the black broth of Sparta, was no other than a kind of cuttle-fish soup, in which the black liquor of the animal was always added as an ingredient; being, when recent, of a very agreeable taste.

Mr. Pennant, in the fourth volume of his British Zoology, speaking of the eight-armed cuttle, tells us, he has been well assured from persons worthy of credit, that in the Indian seas this species has been found of such a size as to measure two fathoms in breadth across the central part, while each arm has measured nine fathoms in length; and that the natives of the Indian isles, when sailing in their canoes, always take care to be provided with hatchets, in order to cut off immediately the arms of such of those animals as happen to fling them over the sides of the canoe, lest they should pull it under water and sink it. This has been considered as a piece of credulity in Mr. Pennant, unworthy of a sober naturalist. It is certain, however, that a great variety of apparent authentic evidences seem to confirm the reality of this account. The ancients, it is evident, acknowledged the existence of animals of the cuttle-fish tribe of a most enormous size; witness the account given by Pliny and others of the large polypus as he terms it, which used to rob the repositories of salt-fish on the coasts of Carteria, and which, according to his description, had a head of the size of a cask that would hold fifteen amphoræ; arms measuring thirty feet in length, of such a diameter that a man could hardly clasp one of them, and beset with suckers or fasteners of the size of large basins that would hold four or five gallons apiece. The existence, in short, of some enormously large species of the cuttle-fish tribe, in the Indian and northern seas, can hardly be doubted; and though some accounts

have been much exaggerated, yet there is sufficient cause for believing, that such species very far surpass all that are generally observable about the European seas. A modern naturalist chooses to distinguish this tremendous species by the title of the colossal cuttle-fish, and seems amply disposed to believe all that has been related of its ravages. A northern navigator, of the name of Dens, is said some years ago to have lost three of his men in the African seas, by a monster of this kind, which unexpectedly made its appearance while these men were employed, during a calm, in raking the sides of the vessel. The colossal cuttle-fish seized these men in its arms, and drew them under water, in spite of every effort to preserve them: the thickness of one of the arms, which was cut off in the contest, was that of a mizen-mast, and the acetabula, or suckers, of the size of large pot-lids.

But what shall we say to the idea of a modern French naturalist, who is inclined to suppose, that the destruction of the great French ship, the Ville de Paris, taken by the English during the American war, together with nine other ships which came to her assistance on seeing her fire signals of distress, was owing, not to the storm which accompanied the disaster, but to a groupe of colossal cuttle-fishes, which happened at that very time to be prowling about the ocean beneath these unfortunate vessels?

These accounts, whether true or false, naturally recal to our recollection the far-famed monster of the northern seas, often mentioned, in a vague manner, under the name of Kraken or Korven. The general tenor of these accounts, is, that in some parts of the northern seas, during the heat of summer, while the sea is perfectly calm, a vast mass, resembling a kind of floating island, about a quarter of a mile in diameter, is seen to rise above the surface: appearing to be covered with a profusion of sea-weeds, corals, and other marine substances. When it is fully risen, it seldom fails to stretch up several enormous arms, of such a height as to equal that of the masts of a ship; and after having continued in this position for some time, it again slowly descends. From the general description thus given of its shape, it has been supposed that it is a species of sepia, or cuttle-fish. Linnæus, in the first edition of his work, entitled Fauna Suecica, as well as in the earlier editions of his Systema Naturæ, seems inclined to admit the existence of this animal, and forms a genus for it, under the name of microcosmus.

2. *Actinia, or Sea-Anemone.*

The beautiful genus thus denominated from its resemblance to the flower of this name when its feelers or tentacles are expanded, is characterized by having an oblong body, of an extensile and expansile nature, and adhering by the base to rocks and other marine substances. The mouth is situated in the centre of the upper part or disc, and is surrounded by very numerous, soft, extensile feelers, or arms, spreading in the manner of rays, and disposed in a single, double, or triple series, according to the different species. The Actiniæ are very common on the rocks of most of the European coasts: when in their contracted state, they have the appearance of inanimate rounded masses of coloured pulp, or flesh; and when expanded, they greatly resemble the appearance of an expanded polypetalous flower, particularly those of the anemone and ranunculus tribe. One of the most common British species is the actinia varia *, found on most of our coasts, and varying *ad infinitum* in its colours, being either red, olive, green, of different shades, and either plain or variously spotted: its principal character, and which distinguishes it in whatever variety of general colour it may happen to appear, consists in a row of short bead-like prominences, surrounding the external row of tentacula: these bead-like processes are invariably of a bright blue colour. The actinia varia in general, measures about two inches in diameter, at the base, but is occasionally seen of a larger size.

A more beautiful species is, however, found on our own coasts; generally imbedding itself in the sand, instead of adhering to rocks; it is called the actinia crassicornis, and is distinguished by its red colour, and roughish external surface; while the central or middle part, when expanded, is white, most elegantly marked near the base of the tentacula, with numerous carmine-coloured streaks: the tentacula themselves, being of a pearl-colour, and of a much thicker or more swelled appearance than in most other species. The actinia crassicornis often measures four, five, or even six inches in diameter when in its expanded state.

The actiniæ, or sea-anemonies, are naturally very voracious animals, preying not only on the softer sea-animals, but on such as are

* Act. Mesembryanthemum. Ellis. Gmel. Syst. Nat.

guarded by a shelly defence; they swallow various kinds of univalve shell-fish, the smaller kind of crabs, and other animals; and when they have absorbed the juices of their prey, they reject the shell or other integument by the mouth. When kept in vessels of sea-water, which may be easily practised, they seem to require no particular nutriment, absorbing a sufficient quantity of animal gluten, from the sea-water itself, for all the purposes of nutrition. In this confined state they do not grow or increase in size, though they frequently produce a numerous offspring, being of a very prolific nature, and viviparous. The young are produced of various sizes, from that of a pin's head to that of half an inch in diameter, and to the number of five, ten, or more at a birth. As these animals are allied to the polype tribe in some degree, they partake of their qualities, and will reproduce many of their organs, when either purposely or accidentally mutilated.

3. *Asterias, or Star-Fish.*

Most of these are of a stellated or radiated shape, as their name imports; the rays differing in number in different species, from five to ten or twelve. The most curious of the whole tribe, is A. Caput Medusæ, of Linnæus, or Medusa's head star-fish. It grows to a large extent, measuring more than two feet in diameter when the limbs are fully extended. This very extraordinary animal is first divided into five equidistant, jointed processes, each of which is soon subdivided into two other smaller ones; and each of these, at a somewhat farther distance, into two others, still smaller; this mode of regular subdivision, being continued to a vast extent, and in the most beautiful gradation of minuteness, till at length the number of extreme ramifications amounts to several thousands. By this most curious structure, the animal becomes, as it were, a kind of living net; and is capable of catching such creatures as are destined for its prey, by the sudden contraction of all its innumerable ramifications, and thus the object is secured beyond all power of escape. Examples of this animal, well worthy of notice, are to be found in the British, and were formerly in the Leverian Museum.

The sea-stars, in general, have a very considerable degree of reproductive power; and if injured by accidental violence, or if one or more of the limbs be cut or torn off, the animal will in time be furnished with new ones. They wander about the ocean in quest of

Engraved by Sim from a Drawing by Gonnet

For the Gallery of Nature & Art.

PAPER NAUTILUS. PEARLY NAUTILUS.

prey, more particularly near the shores; and feed not only on the softer sea-animals, but on the smaller shell-fish. Their mouth, which, as before observed, is situated beneath, is armed with hard and sharp teeth, resembling a kind of spines, and converging towards the centre of the mouth, and differing in number in the different species. We should not omit to observe, that the curious species last mentioned, the Medusa's head star-fish, is chiefly confined to the Indian seas, but is sometimes found in those of Europe. Those who may wish for a particular description of the anatomy of the star-fishes, may consult the observations of Reaumur on this subject, published in the Memoirs of the French Academy.

[*Shaw.*

SECTION V.

Testaceous Worms, or those possessing Shells.

We have already seen that these consist of three divisions, according to the number of valves or pieces of which the entire covering consists; and hence these divisions are denominated univalves, bivalves, and multivalves. We shall select a few of the most curious instances of each.

Among the UNIVALVES, or those possessing only a single shell, the most common perhaps are the snail, (helix,) and the perri-winkle, (turbo,) kinds. Among the most interesting are the paper-nautilus, the pearl-nautilus, and the ship-worm. The animals inhabiting this description of shells, are, for the most part, the slug and the cuttle-fish.

1. *Paper Nautilus.*

Argonauta Argo.—LINN.

"Among the principal miracles of nature," says Pliny, "is the animal called nautilos, or pompilos. It ascends to the surface of the sea in a supine posture, and gradually rising itself up, forces out, by means of its tube, all the water from the shell, in order that it may swim the more readily; then throwing back the two foremost arms, it displays between them a membrane of wonderful tenuity, which acts as a sail, while with the remaining arms it rows itself along; the tail in the middle acting as a helm to direct its

course: and thus it pursues its voyage; and if alarmed by any appearance of danger, takes in the water and descends."

The paper nautilus is an inhabitant of the Mediterranean and Atlantic seas. In the Indian seas is found a species so similar, that it has generally been considered as a variety: it differs in having the shell marked into numerous slight tubercles on each side the furrows. This is the variety described by Rumphius, in his account of its inhabiting animal, observed by him during his residence at Amboyna.

[*Edit. Plin. Shaw.*

2. *Pearl Nautilus.*

Nautilus Pompilius.—LINN.

This animal possesses a large and strong shell, often measuring five or six inches in length: it is of a very firm or dense fabric, of a shape somewhat compressed on the sides, with a very wide opening or mouth, and with the back-part rolled into a spiral form within the cavity of the shell. The colour, externally, is a dull yellowish-white, marked with numerous zebra-like yellowish brown or dusky bands; and within, of the richest and brightest silvery-pearl-colour. When the natural pellicle or epidermis of the outside is rubbed off, the whole shell appears silvery also. The great and striking character of the genus however, at least so far as regards the shell, is the extraordinary structure of the internal part, which is formed into a great number, (from thirty to forty) separate chambers or divisions, each communicating with the rest by a small tubular hole near the centre. The opening or mouth of the shell therefore presents a large but shallow concavity, pierced with a central or nearly central hole, and beyond lie all the divisions before-mentioned. The body or chief part of the inhabiting animal fills up the front or great concavity, and that only; while from its extremity proceeds a slender tail or process, passing through all the rest of the chambers; and it has been supposed by some, that the animal possesses the power of, at pleasure, filling up the chambers or cavities, either with air or water, or of exhausting them of both occasionally, in order to make itself specifically heavier or lighter, during its navigations; for this animal is also supposed to have a power of sailing, though in a less perfect manner than the argonaut, or paper

nautilus. The animal is also indistinctly allied to the cuttle-fish tribe; having an oval body, with the front or central part furnished with a parrot-shaped beak, and surrounded by arms or tentacula; but they differ from those of the sepiæ or cuttles, in being very short, extremely numerqus, disposed in several concentric rows or circles, and not beset with any visible suckers. From above the neck, or round the upper part of the head, rises a large, concave flap or hood, beset on the inside with numerous but small suckers, or concave tubercles. By the elevation and expansion of this concave flap, or hood, the animal of the pearly nautilus is supposed to sail. It is of a pale reddish-purple colour, with deeper spots and variegations.

[*Shaw.*

Ship-Worm.

Teredo Navalis Linn.

This is long a worm, covered with a calcareous shell; the shell is smooth, thin, cylindrical, more or less twisted, rather obtuse at the hip; from four to six inches in length. The same worm is not unfrequently found naked, or destitute of its shell, and is then called Terebella, or naked ship-worm; it has the same habits as the Teredo, and pierces planks nearly as readily. The ship-worm is a native of the Indian Seas, from whence it has been imported into Europe. It penetrates easily into the stoutest oak-plank, and produces dreadful destruction to the ships, by the holes it makes in their sides; and it is to avoid the effects of this insect that vessels require sheathing.

The head of this creature is well prepared by nature for the hard offices which it has to undergo: being coated with a strong armour, and furnished with a mouth like that of the leech, by which it pierces wood as that animal does the skin. A little above this it has two horns, which seem a kind of continuation of the shell; the neck is as strongly provided for the service of the creature as the head, being furnished with several strong muscles; the rest of the body is only covered by a very thin and transparent skin, through which the motion of the intestines is plainly seen by the naked eye; and by means of the microscope several other very remarkable particulars become visible there. This creature is wonderfully minute when

newly excluded from the egg; but it grows to the length of four or six inches, and sometimes more.

When the bottom of a vessel, or any piece of wood which is constantly under water, is inhabited by these worms, it is full of small holes; but no damage appears till the outer parts are cut away: then their shelly habitations come to view; in which there is a large space for inclosing the animal, and surrounding it with water. There is evident care in these creatures never to injure one another's habitations, by which means each case or shell is preserved entire; and in such pieces of wood as have been found eaten by them into a sort of honeycomb, there is seen no passage or communication between any two of the shells, though the woody matter between them often is not thicker than a piece of writing-paper. They penetrate some kinds of wood more easily than others. They make their way most quickly into fir and alder, and grow to the greatest size. In the oak they make little progress, and appear small and feeble, and their shells much discoloured.

Since each of these animals is lodged in a solitary cell, and has no access to those of its own species, it has been matter of surprise how they should increase to so vast a multitude. Upon dissecting them, it appears that every individual has the parts of both sexes, and is therefore supposed to propagate by itself.

The sea-worms, which are pernicious to our shipping, appear to have the same office allotted to them in the waters which the termites have on the land. They will appear, on a very little consideration, to be most important beings in the great chain of creation; and pleasing demonstrations of that infinitely wise and gracious Power which formed, and still preserves, the whole in such wonderful order and beauty; for if it were not for the rapacity of these and similar animals, tropical rivers, and indeed the ocean itself, would be choked with the bodies of trees which are annually carried down by the rapid torrents, as many of them would last for ages; and probably be productive of evils, of which, happily, we cannot in the present harmonious state of things form any idea; whereas now, being consumed by these animals, they are more easily broken in pieces by the waves; and the fragments which are not devoured become specifically lighter, and are consequently more readily and more effectually thrown on shore; where the sun, wind, insects, and various other instruments, speedily promote their entire dissolution.

About the year 1730, the Republic of Holland was thrown into a general alarm by the appearance of a vast multitude of these worms on the coast; and a very extensive depredation which they commenced on the wood work of the dykes, threatening a total destruction to the republic. Fortunately they disappeared in a few years, perhaps in consequence of the climate being too cold for them.

[*Adanson. Phil. Trans.* 1739. *Editor.*

Of the BIVALVE testaceous worms, or those possessing a shell composed of two divisions, the most common examples perhaps are the oyster (ostrea,) the cockle (cardium,) and the muscle (mytilus.) Among the more curious or extraordinary we may mention the pearl-muscle, the chama, or great clamp-shell, and the pinna.

1. *Pearl Muscle, or Mother-of-Pearl Shell.*

Mytilus margaritiferus.—LINN.

This shell, which grows to a very considerable size, is of a flattened and rounded shape, with the back or hinge part strait. Its colour on the outside is brown, variously spotted and clouded according to circumstances; and on the inside, as every one knows, of the most brilliant, iridescent, silver lustre. It is a shell of very considerable thickness; and when properly cut and polished is the beauful substance usually known by the name of mother-of-pearl, and of which so many ornamental articles are formed; and from the cartilaginous or tendinous hinge at the back part of the shell, in a petrified state, is produced that very rare and beautiful extraneous fossil, called the Androdamas, (the Helmintholithus Androdamas of Linnæus,) which when cut and polished, in the disposition of its fibres, and in its colours, bears some resemblance to the eye of a peacock's feather. But the far more valuable products of this shell are pearls themselves, which are found sometimes loose, and sometimes adhering to the shell, as well as in the body of the animal.

The pearl muscle, or Mytilus margaritiferus, is most common about the shores of the East-Indian islands; and particularly at Ceylon, where the chief pearl-fisheries have long been established, and of which an interesting description may be found in the Asiatic Researches, and other publications. According to the tenor of these accounts, one of the chief pearl-fisheries of Ceylon is carried on, at

different periods, in a semilunar bay called the bay of Condatchy, surrounded by a waste, sandy district: during the fishing-season this bay is said to offer a scene equally novel and astonishing; being frequented by a heterogeneous mixture of thousands of people of different nations, casts, and colours, residing in tents and huts erected on the surrounding shores: you here meet with brokers, jewellers, and merchants of all descriptions, as well as dealers in all kinds of provisions; but by far the greater number are engaged in the pearl-business itself; in drilling, sorting, and otherwise preparing them for sale. The drawbacks against this scene of entertaining confusion are, the offensive atmosphere occasioned by the putrefaction of the innumerable pearl-muscles lying in heaps on the shores; the badness of the water round the spot, which is so brackish as scarcely to be drinkable; the extreme heat of the weather during the day, and the coldness and heavy dews of the night. The pearl-fishery therefore of Ceylon is extremely injurious to the health of those who engage in it, and frequent it. The Ceylonese pearl-divers are said to make use of no particular precautions in exercising their occupation, but descend to the bottom at the depth of from five to ten fathoms by means of a large stone, fastened to them with a rope; and being furnished with a basket, they collect, with as much expedition as possible, such shells as happen to lie about the spot of their descent, continuing their search about two minutes, when, according to a signal which they make to the boat to which their cord is attached, they again ascend with their treasure. It is added that each diver will, in general, bring up as many as one hundred pearl-shells of various sizes in his net; and that, from long habit, some of these Indian divers become so expert as to be able to continue under water for the space of six or seven minutes.

This reminds us of the famous Sicilian diver mentioned by Kircher and others, who could remain so long under water, that he obtained the popular title of Fish. Frederic, King of Sicily, unthinkingly tempted him by the offer of a golden cup thrown into the sea, to dive near the gulph of Charybdis: he made two attempts, and each time astonished the spectators by the time he remained under water; but in the third attempt he was, as is supposed, caught in the eddy of the whirlpool, and never again appeared. An ingenious French naturalist is of opinion that he was caught by a colossal cuttle-fish!! The accounts, however, of the Sicilian writers are against this supposition, since they affirm that his body

was thrown up on the coast, at above thirty miles distance from the spot where he descended. With respect to the animal inhabiting the pearl-shell, it is (we know) popularly called the pearl-oyster; but in reality belongs to the Linnæan genus Mytylus. It is furnished with a lengthened tubular tongue or soft trunk, by the assistance of which it deposits a small drop of a glutinous fluid on whatever place or substance it wishes to attach itself to, and then, suddenly withdrawing the trunk, forms, in consequence, a thread or ligament; and repeating this operation a great many times, fastens itself by a short silken tuft. In the soft or pulpy part of the body of the animal are found the pearls; the real nature and production of which, as to the œconomy of the animal, is perhaps still in a great degree unknown. The idea of Reaumur is not improbable: viz. that the pearls are formed like the concretions called bezoars in quadrupeds, and some other animals. It is said that between one and two hundred pearls have been sometimes found within a single pearl-muscle. Though the general colour of the shell and the pearl is silvery, yet some have been found of a deep red, and others of a pink colour. It is farther observable, that a pearl, when cut through, frequently exhibits some extraneous body, as a grain of gravel or other substance in the centre, round which the several lamellæ or concentric concretions have been formed *. Besides those found in the body of the animal, several are often observed rising from the internal surface of the shell, to which they are closely attached, so as not to be completely round, and are therefore considered as of little value. The largest pearl-shells, and such as are most encrusted with extraneous marine substances, as Serpulæ, Corals, &c. are in general observed to be most productive of pearls; while the smaller and smoother shells afford but few, or so small as to be of no importance in commerce.

In addition to what has been said relative to Pearls, we may add, that irregular or grape-shaped pearls sometimes occur, which seem to be owing to a coalescence of several smaller ones into one mass. One of the noblest pearls on record is that which Cleopatra is absurdly said to have dissolved in vinegar, during an entertainment

* According to Cuvier, pearls may be considered as formed by an extravasation of the calcareous matter with which the animal is furnished, for the augmentation of its shell.

which she gave to Mark Antony, and afterwards to have drank it. We must surely suppose that she caused it to be well bruised first, before she put it into the vinegar. It was a pearl belonging to a pair of her ear rings: the fellow to it is said to have been sent to Rome, and after being properly cut in two, formed a pair of pendants for the ears of a celebrated statue of Venus in that city. It may not be improper to observe, that the elegant manufacture of what are called false or artificial pearls, which sometimes so nearly equal true ones in beauty as to be very difficultly distinguished from them, is originally a French invention, and is still carried on in its greatest perfection at Paris. The thin glass bubbles used for this purpose have their inside lined by a pearl-coloured substance, thrown into them through a small tube; the pearl-coloured substance is prepared by well beating the silvery scales of fishes, and particularly of bleaks, in water, which being poured away, the silvery sediment undergoes several other ablutions, and being then mixed with proper agglutinating ingredients, is used in the manner just described. The inventor is said to have been a bead-maker of the name of Jacquin, and to have lived about the time of Henry the Fourth. This man observed, that on washing the scales of the Bleak, a most beautiful silver-coloured powder was obtained; and it occurred to him, that by introducing this substance into the inside of finely-blown glass beads, slightly tinged with opaline hues, a perfect imitation of real pearls might be made: (for an attempt of a similar nature had some years before been made in Italy, by filling glass bubbles with quicksilver; but which was immediately discouraged; first, on account of the pearls so prepared wanting the true colour, and because they were judged to be dangerous by the physicians.) Jacquin was at first put to great difficulty in preserving the silver-coloured powder, which, if not used quickly, becomes putrid, and diffuses an intolerable smell. Attempts were made to preserve it in spirits, but by this method the lustre was entirely destroyed. It was at length found, that volatile alkali possessed the power of preserving the substance without injury to its colour. Many years elapsed before the false pearls became very common; and even so late as the reign of Louis the Fourteenth, it is said that a French Marquis who possessed very little property, but who was violently in love with a particular lady, gained her affections by presenting her with a rich string of these pearls, which cost him but three Louises, but which the lady, supposing them to be real ones, valued at a very high sum.

The servant, who put the Marquis upon this stratagem, had previously assured his master that these pearls withstood heat and moisture; that they were not easily scratched, and that their weight was the same with that of real pearls. This anecdote, which is detailed by Professor Beckman, proves that artificial pearls did not become common, even in France, till many years after their first invention.

The trade of artificial pearl-making is still carried on at Paris by the descendants of Jacquin, the original inventor; but they are also made in many other parts of Europe, and with several variations as to the colour and kind of the glass, and other minute particulars.

The mytilus margaritiferus of Linnæus, or great pearl muscle, is not the only shell which produces pearls. A species of the genus called mya, and which is the mya margaritifera of Linnæus, also produces pearls, though, in general, of a far smaller size, and of inferior quality. This shell is commonly called the European pearl muscle, and much resembles the common river muscle, though of a different genus. It is found in rivers in the north of England, in Scotland, Ireland, and many other parts of Europe. In the seventeenth century several rich pearls of large size are said to have been obtained from this shell, in some of the rivers of Ireland. One was valued at upwards of 4*l.*, another at 10*l.*, and a third at no less than 40*l.* As a species, the European pearl-muscle, or more properly, mya, is distinguished by having a thick, coarse, blackish shell, generally barked or decorticated towards the hinge *.

I have before mentioned, when speaking of the real or Indian pearl-shell, the French art of making artificial pearls. There exists also an art, said to be often practised by the Chinese, and which Linnæus attempted to put in practice in Europe, of forcing, as it were, the production of pearls, in the mya margaritifera, or European pearl muscle, by piercing the outside of the shell in several places, so as barely not to make complete perforations. In this case, the animal, conscious of the weakness or deficiency of the shell in those spots, soon begins to secure the weakened parts by depo-

* Pearly concretions are also occasionally formed in all shells, and are of different colours, according to that of the shell in which they are formed. Thus, the animal of the large univalve shell, called the strombus gigas, or great rose-mouthed strombus, sometimes produces pearly concretions of a fine rose-colour.

siting over them a great quantity of its pearly calcareous matter, and thus forms so many pearly tubercles over them. The practice however is, I believe, considered as not of importance sufficient to make it an object of gain, but rather of mere curiosity; the pearly tubercles thus obtained being of inferior beauty to those more naturally produced.

[*Shaw.*

2. *Great Clamp Shell.*

Chama Gigas.—LINN.

This is by far the largest and heaviest of the testaceous tribes. The animal, and even the shell itself, has a considerable resemblance to an immense oyster. The shell is plated, however, with arched scales; the posterior slope gaping with a crenulate margin. It is an inhabitant of the Indian Seas, and has sometimes been found of more than three feet long, and five hundred pounds in weight; the fleshy part, or inhabitant, large enough to furnish a hundred and twenty-seven men with a good meal; and strong enough to cut asunder a cable, and lop off men's hands. Specimens of this shell in its full growth are not very common, from its being unwieldy; but they may be seen in the British Museum.

[*Lister. Klein. Editor.*

3. *Sea-Pinna.*

Pinna rudis.—LINN.

The animal in this genus of shell-worms, is considered by Linnæus as allied to a Limax or slug, and consequently to the snail tribe also. Some of the species and varieties of pinna are very large shells, of a thin structure in proportion to their size: and they are generally affixed to rocks or other objects, by a large tuft of very fine but strong silken fibres or threads, which the animal has the power of forming, by thrusting out a kind of pointed trunk, with which it touches the object it wishes to adhere to, and by retracting it, forms a glutinous thread; and, by the repetition of this motion, forms the whole tuft by which it is fastened.

The large sea-pinna, or pinna rudis, is a curious instance of this. This shell is brown externally, with a slightly iridescent silvery cast within; of a lengthened shape, with a very narrow base, and dilated

and rounded towards the extremity. It is a frequent inhabitant of the European coasts; and in some places, as about the coasts of Sicily and Italy, the silken tufts are often collected, and spun into various articles of dress, as gloves in particular; the silk requiring no dye, but retaining its native colour, which is an elegant, glossy, yellowish brown. Specimens of this kind of silk are generally to be seen in most of our museums. Neither is this faculty of fastening, or anchoring by means of silken fibres, confined to the genus pinna, but takes place, as we have already seen, in the genus mytilus, and probably in some of the rest.

[*Shaw.*

The MULTIVALVES, or shell-worms, whose shell consists of three or more than three parts. And of these there are but three described kinds; the chiton, lepas, and phloas; the last of which is worthy of notice on various accounts; the shell is bivalve, with several shallow differently shaped accessory shells at the hinge; hinges recurved, united by a cartilage; in the inside beneath the hinge is an incurved tooth. The inhabitants of this genus perforate clay, spongy stones, and wood, while in their younger state: and as they increase in size, enlarge their habitation within, and thus become imprisoned: they contain a phosphorous liquor of great brilliancy in the dark, and which illuminates whatever it touches or happens to fall upon.

It is equally extraordinary by what means this curious worm is able to burrow and work its way in the midst of massy stones, as the nature of the phosphorous light which it so copiously secretes. The organ by which it appears to work is a fleshy substance, placed near the lower extremity of the shell, of the shape of a lozenge, and considerably large in proportion to the size of the animal; it is by perseverance alone, therefore, and by great length of time, that it is able to scoop out an augmentation to the cavity it inhabits. The minute opening by which the worm, when very small, insinuated itself into the interior of the substance it inhabits, is generally to be traced; and at once subverts the absurd opinion of those who have asserted that the phloas is at first hatched in these holes.

The light emitted is of a very peculiar kind. Its existence has been long known, for it is noticed by Pliny, who observes that it shines in the mouth of the person who eats it, and makes him lumi-

nous if it touch but his hand or clothes. Putrescency, though not putrefaction, is necessary for the discharge of the light possessed by phosphorescent fishes; in the phloas, on the contrary, the light is rendered brighter in proportion to the freshness of the animal. The moisture of salt or fresh water revives it; brandy suddenly extinguishes it; vinegar not quite so soon. It is probable that this worm often contributes to the luminous appearance of the sea.

Various experiments have been made to render the light or luminous matter secreted by the phloas permanent, but none have altogether succeeded. Reaumur kneaded the juice into paste with flour, and found that the paste would give light when immersed in warm water. But the best way to preserve the light, is to preserve the worm, or fish, as it is usually called, in honey; in which state, whenever taken out, and plunged in warm water, it will give a very brilliant light for a twelvemonth afterwards. Milk, however, appears to be rendered more luminous by this phosphorous matter than any other liquid; a single phloas made seven ounces of milk so luminous, that the faces of persons in the dark could be seen and distinguished by it.

There are twelve species of this curious animal; three of which are common to the seas of our own coast.

[*Pantologia.*

SECTION VI.

Intestinal Worms.

THESE are more properly called worms than any of the preceding. They are ordinally characterised as simple, naked animals, without limbs of any kind: and derive their ordinal name from inhabiting the bowels of the earth, water, or animals of various kinds. Among the more common tribes we may mention the lumbricus or earth-worm, including the *dew* and the *lug*; the hirudo or leech; the limax or slug; the ascaris, comprehending both the thread and the long mud intestinal worm; and the tænia or tape-worm. Among the more curious are the furia, the gordius or hair-worm, and the filaria, or Guinea-worm.

1. *Hair-worm.*

Gordius aquaticus.—LINN.

This resembles a horse-hair in its shape, and is hence often denominated *horse-hair worm*, or *seta equina.* It inhabits soft stagnant waters, is from four, to six inches long; and twists itself into various knots and contortions. Linnæus asserts, that in Sweden its bite or sting is supposed to produce the complaint called a *whitlow*, and that he once knew this rumour verified: and Dr. Shaw declares that he also once beheld the complaint follow upon the sting of a gordius, though he leaves it doubtful whether the complaint might not have occurred, if the sting had not been inflicted.

[*Nat. Miscel. Turton. Linn.*

2. *Guinea Worm.*

Filaria medinensis.

In this genus of worms the body is round, filiform, equal and quite smooth; mouth dilated, with a roundish lip. There are eighteen species:

A. infesting mammals.
B. ——— birds.
C. ——— insects when perfect.
D. ——— insect larves.

The division A. is found in different varieties in man, the cellular membrane of the horse, in the lion, the martin, and hare. B. In hawks, owls, crows, storks, and poultry. C. In the scarabæus fimetarius; silpha obscura, carabas, and gryllus. D. In the papilio articæ; p. betulæ; p. quercus; sphinx Euphorbiæ; phalæna caja; ph. quercus; ph. pellionella; found under the skin of the larves, and very destructive to them; sometimes solitary, and from four to seven inches long. The species chiefly worthy of notice is, F. medinensis, of the division A, is the dracunculus, or Guinea-worm. The body is entirely pale yellowish. It inhabits both the Indies, and is frequently in the morning dew, whence it enters the naked feet of the slaves, and creates the most troublesome itchings, generally accompanied with inflammation and fever. It must be cautiously drawn out by means of a piece of silk tied round its head:

for if, by being too much strained, the animal should break, the part remaining under the skin grows with redoubled vigour, and often occasions a fatal inflammation. It is frequently twelve feet long, and not larger than a horse-hair.

[*Syst. Nat. Turton. Sloane.*

3. *Fury, or Fùria.*

Furia infernalis.—LINN.

THERE is only one species of this genus; and it is denominated, *Fury*, not without good reason, if we may rely on the accounts which have been given of the torments it sometimes inflicts on the person it happens to attack. Its character is a thin, thread-shaped body, edged along each side with a row of sharp, reversed prickles, lying close to the edge of the body, or at very acute angles. It bears a resemblance therefore to a minute scolopendra, or centipede; and from the structure of its body, is enabled to perforate the skin in an instant, so as not to be extracted without extreme difficulty. It is pretended that this worm, in the marshy parts of Sweden, and some other countries, is conveyed by some means or other through the air, and drops on the bodies of cattle and men; producing almost immediately a pain so insupportable, as sometimes to prove fatal in the space of a quarter of an hour. Linnæus tells us that he himself once experienced the effects of this animal, near the city of Lund, in Sweden. Dr. Solander once gave a slight description of this worm; but from the difficulty of obtaining recent specimens, its nature is still obscure; and even its very existence has been occasionally doubted; particularly by Blumenbach and Muller. There seems, however, to be no good reason for questioning the existence of some such animal, though the accounts of its extraordinary qualities may have been exaggerated. The best account of it is in a quarto pamphlet, published by a Dr. Hagen, as an academical thesis: in which all the observations relative to it are summed up in a concise manner, and its real existence, seemingly, well ascertained. It is said to be generally about three-quarters of an inch long.

[*Muller. Shaw.*

CHAP. III.

INSECTS.

Insecta.—LINN.

SECTION I.

Death-Watch.

Ptinus Fatidicus.—LINN.

THE genus Ptinus, like that of Dermestes, or book-worm, consists of small insects which, in general, have similar habits, living both in their larva and complete state among dry animal substances, and some species in dry wood, committing great havock among the older articles of furniture, which they pierce with innumerable holes, thus causing their gradual destruction.

To this genus belongs the celebrated insect distinguished by the title of the death watch, or ptinus fatidicus. Among the popular superstitions which the almost general illumination of modern times has not been able to obliterate, the dread of the death-watch may well be considered as one of the most predominant, and still continues to disturb the habitations of rural tranquillity with groundless fears, and absurd apprehensions. It is not indeed to be imagined that they who are engaged in the more important cares of providing the immediate necessaries of life, should have either leisure or inclination to investigate with philosophic exactness the causes of a particular sound: yet it must be allowed to be a very singular circumstance, that an animal so common should not be more universally known, and the peculiar noise which it occasionally makes be more universally understood. It is chiefly in the advanced state of spring that this alarming little animal commences its sound, which is no other than the call or signal by which the male and female are led to each other, and which may be considered as analogous to the call of birds; though not owing to the voice of the insect, but to its beating on any hard substance with the shield or fore-part of its

head. The prevailing number of distinct strokes which it beats is from seven to nine, or eleven; which very circumstance may perhaps add, in some degree, to the curious character which it bears among the vulgar. These sounds or beats are given in pretty quick succession, and are repeated at uncertain intervals; and in old houses where the insects are numerous, may be heard at almost every hour of the day; especially if the weather be warm. The sound exactly resembles that which may be made by beating moderately hard with the nail on a table. The insect is of a colour so nearly resembling that of decayed wood, viz. an obscure greyish brown, that it may for a considerable time elude the search of the enquirer. It is about a quarter of an inch in length, and is moderately thick in proportion, and the wing-shells are marked with numerous irregular variegations of a lighter or greyer cast than the ground-colour. In the 20th and 22d volume of the Philosophical Transactions, may be found a description of this species by the celebrated Derham, with some very just observations relative to its habits and general appearance; and it seems singular that so remarkable an insect should have almost escaped the notice of more modern entomologists. In the twelfth edition of the Systema Naturæ of Linnæus it does not appear; but is probably the Dermestes tesselatus of Fabricius, in which case he seems to have placed it in a wrong genus. Ridiculous, and even incredible as it may appear, it is an animal that may in some measure be tamed: at least it may be so far familiarized as to be made to beat occasionally, by taking it out of its confinement, and beating on a table or board, when it will readily answer the noise, and will continue to beat as often as required.

We must be careful not to confound this animal, which is the real death-watch of the vulgar, emphatically so called, with a much smaller insect of a very different genus, which makes a sound like the ticking of a watch, and continues it for a long time without intermission. It belongs to a totally different order, and is the Termes pulsatorium of Linnæus.

[*Naturalist's Miscell.*

SECTION II.

Glow-Worm.

Lampyris noctiluca.—LINN.

Lantern-Fly.

Fulgora lanternaria.—LINN.

THERE are various worms, insects, and fishes, that have a power of emitting, perhaps of secreting spontaneously, a considerable portion of light. The subject is curious, and we shall treat of it generally in a subsequent chapter. Among these singular animals, the two we have placed at the head of the present section are the most distinguished. They do not belong to the same order under the systematic arrangement of Linnæus, but we have for the present united them, on account of their correspondence in this respect.

The LAMPYRIS NOCTILUCA, or GLOW-WORM, is a highly curious and interesting animal. It is seen during the summer months, as late as the close of August, if the season be mild, on dry banks, about woods, pastures, and hedgeways, exhibiting, as soon as the dusk of the evening commences, the most vivid and beautiful phosphoric splendour, in form of a round spot of considerable size. The animal itself, which is the female insect, measures about three-quarters of an inch in length, and is of a dull earthy brown colour on the upper parts, and beneath more or less tinged with rose-colour; with the two or three last joints of the body of a pale or whitish sulphur-colour. It is from these parts that the phosphoric light abovementioned proceeds, which is of a yellow colour, with a very slight cast of green: the body, exclusive of the thorax, consists of ten joints or divisions. The larva, pupa, and complete female insect scarcely differ perceptibly from each other in general appearance, but the phosphoric light is strongest in the complete animal. The glow-worm is a slow-moving insect, and in its manner of walking frequently seems to drag itself on by starts or slight efforts as it were. The male is smaller than the female, and is provided both with wings and wing-sheaths: it is but rarely seen; and it seems, even at present, not very clearly determined whether it be luminous

or not. The general idea among naturalists has been that it is not, and that the splendour exhibited by the female in this species is ordained for the purpose of attracting the male. This circumstance is elegantly expressed in some beautiful lines of Mr. Gilbert White, in his History of Selburne.

> "The chilling night-dews fall; away, retire;
> For see, the glow-worm lights her am'rous fire!
> Thus, ere night's veil had half-obscur'd the sky,
> Th' impatient damsel hung her lamp on high:
> True to the signal, by love's meteor led,
> Leander hasten'd to his Hero's bed."

Dr. Darwin also, in his admired poem the Botanic Garden, commemorates the splendour of the glow-worm among other phænomena supposed to be produced under the superintendance of the nymphs of fire.

> "You with light gas the lamps nocturnal feed
> That dance and glimmer o'er the marshy mead;
> Shine round Calendula at twilight hours,
> And tip with silver all her saffron flowers;
> Warm on her mossy couch the radiant worm,
> Guard from cold dews her love-illumin'd form,
> From leaf to leaf conduct the virgin light,
> Star of the earth, and diamond of the night!"

It is certain that in some species of this genus the male as well as the female is luminous, as in the lampyris italica, which seems to be a native of our own island also, though less common here than in the warmer parts of Europe. Aldrovandus describes the winged glow-worm as having its wing-shells of a dusky colour, and at the end of the body two brilliant fiery spots like the flame of sulphur.

In the Philosophical Transactions for the year 1684, we find a paper by a Mr. Waller, describing the English flying glow-worm as of a dark colour, with the tail part very luminous: he maintains that both male and female of this species are winged, and that the female is larger than the male: the light of this insect was very vivid, so as to be plainly perceived even when a candle was in the

room. Mr. Waller observed this species at Northaw, in Hertfordshire. From the figure given by this writer it appears to be about half an inch in length, which is much smaller than the common female glow worm.

In Italy this flying glow-worm is extremely plentiful; and we are informed by Dr. Smith, and other travellers, that it is a very common practice for the ladies to stick them by way of ornament in different parts of their head-dress during the evening hours.

The common or wingless glow-worm may be very successfully kept, if properly supplied with moist turf, grass, moss, &c. for a considerable length of time; and, as soon as the evening commences, will regularly exhibit its beautiful effulgence, illuminating every object within a small space around it, and sometimes the light is so vivid, as to be perceived through the box in which it is kept. This insect deposits its eggs, which are small and yellowish, on the leaves of grass, &c.

The FULGORA LANTERNARIA, or PERUVIAN LANTERN-FLY, is undoubtedly one of the most curious of insects; it is of a very considerable size, measuring nearly three inches and a half from the tip of the front to that of the tail; and about five inches and a half from wing's end to wing's end when expanded: the body is of a lengthened oval shape, roundish or subcylindric, and divided into several rings or segments: the head is nearly equal to the length of the rest of the animal, and is oval, inflated, and bent slightly upwards: the grouad-colour is an elegant yellow, with a strong tinge of green in some parts, and marked with numerous bright red-brown variegations, in the form of stripes and spots: the wings are very large, of a yellow colour, most elegantly varied with brown undulations and spots, and the lower pair are decorated by a very large eye-shaped spot on the middle of each, the iris or border of the spot being red, and the centre half red and half semi-transparent white: the head or lantern is pale yellow, with longitudinal red stripes. This beautiful insect is a native of Surinam and many other parts of South America, and during the night diffuses so strong a phosphoric splendor from its head or lantern, that it may be employed for the purpose of a candle or torch; and it is said that three or four of the insects, tied to the top of a stick, are frequently used by travellers for that purpose. The celebrated Merian, in her work on the insects of Surinam, gives a very agreeable account of

the surprize into which she was thrown by the first view of the flashes of light proceeding from these Insects. "The Indians once brought me, " says she," before I knew that they shone by night, a number of these lantern-flies, which I shut up in a large wooden box. In the night they made such a noise, that I awoke in a fright, and ordered a light to be brought: not knowing then whence the noise proceeded. As soon as we found that it came from the box, we opened it; but were still much more alarmed, and let it fall to the ground in a fright, at seeing a flame of fire come out of it; and as many animals as came out, so many flames of fire appeared. When we found this to be the case, we recovered from our fright, and again collected the Insects highly admiring their splendid appearance."

[*Shaw.*

SECTION III.

Locust Cricket.

Gryllus.—LINN.

THERE are various species belonging to this genus, that are worthy notice in the present place: particularly the migratory locust, the crested cricket, and the mole cricket. We shall give a short description of each in their order.

1. *Migratorius Locust.*

Gryllus migratorius.—LINN.

This species is to be placed among the most noxious of all insects, or those capable of producing the most dreadful and extensive destruction. Legions of these animals are from time to time observed in various parts of the world, where the havoc they commit is almost incredible: whole provinces are in a manner desolated by them in the space of a few days, and the air is darkened by their numbers; nay even when dead they are still terrible; since the putrefaction arising from their inconceivable number is such, that it has been regarded as one of the probable causes of pestilence in the Eastern regions. This formidable Locust is generally of a brownish colour, varied with pale red or flesh-colour, and the legs are frequently blueish. In the year 1748, it appeared in irregular

flights in several parts of Europe, as in Germany, France and England: and in this capital itself and its neighbourhood great numbers were seen: they perished however in a short time, and were happily not productive of any material mischief, having been probably driven by some irregular wind out of their intended course, and weakened by the coolness of the climate.

From a paper published in the 18th volume of the Philosophical Transactions we find that in the year 1693, some swarms of this species of locust settled in some parts of Wales. Two vast flights were observed in the air not far from the town of Dol-galken in Merionethshire; the others fell in Pembrokeshire. From a letter published in the 38th volume of the same work it appears that some parts of Germany, particularly in the March of Brandenburgh, &c. suffered considerable injury from the depredations of these animals. They made their appearance in the spring of the year 1732, from flights which had deposited their eggs in the ground the preceding year. They attacked and devoured the young spike of the wheat, &c. and this chiefly by night, and thus laid waste many acres at a time beyond all hope of recovery. In the 46th volume of the same Transactions, we find a description of the ravages of these animals in Walachia, Moldavia, Transylvania, Hungary, and Poland, in the years 1747 and 1748.

"The first swarms entered into Transylvania in August, 1747: these were succeeded by others, which were so surprisingly numerous, that when they reached the Red Tower, they were full four hours in their passage over that place; and they flew so close that they made a sort of noise in the air by the beating of their wings against one another. The width of the swarm was some hundreds of fathoms, and its height or density may be easily imagined to be more considerable, inasmuch as they hid the sun, and darkened the sky, even to that degree, when they flew low, that people could not know one another at the distance of twenty paces; but, whereas they were to fly over a river that runs in the vallies of the Red Tower, and could find neither resting-place nor food; being at length tired with their flight, one part of them lighted on the unripe corn on this side of the Red Tower, such as millet, Turkish wheat, &c.; another pitched on a low wood, where, having miserably wasted the produce of the land, they continued their journey, as if a signal had actually been given for a march. The guards of the

Red Tower attempted to stop their irruption into Transylvania by firing at them*; and, indeed, where the balls and shot swept through the swarm, they gave way and divided; but, having filled up their ranks in a moment, they proceeded on their journey. In the month of September, some troops of them were thrown to the ground by great rains and other inclemency of the weather, and thoroughly soaked with wet, they crept along in quest of holes in the earth, dung, and straw; where, being sheltered from the rains, they laid a vast number of eggs, which stuck together by a viscid juice, and were longer and smaller than what is commonly called an ant's egg †, very like grains of oats. The females having laid their eggs, die, like the silk-worm; and we Transylvanians found by experience, that the swarm which entered our fields by the Red Tower, did not seem to intend remaining there, but were thrown to the ground by the force of the wind, and there laid their eggs: a vast number of which being turned up and crushed by the plough, in the beginning of the ensuing spring, yielded a yellowish juice. In the spring of 1748, certain little blackish worms were seen lying in the fields and among the bushes, sticking together, and collected in clusters, not unlike the hillocks of moles or ants. As nobody knew what they were, so there was little or no notice taken of them, and in May they were covered by the shooting of the corn sown in winter; but the subsequent June discovered what those worms were; for then, as the corn sown in spring was pretty high, these creatures began to spread over the fields, and become destructive to the vegetables by their numbers. Then at length the country people, who had slighted the warning given them, began to repent of their negligence; for as these insects were now dispersed all over the fields, they could not be extirpated without injuring the corn. At that time they differed little or nothing from our common grass-hopper, having their head, sides, and back, of a dark colour, with a yellow belly, and the rest of a reddish hue. About the middle of June, according as they were hatched, sooner or later, they were generally a finger's length, or somewhat longer, but their shape and

* In the eastern parts of the world it is often found necessary for the governors of particular provinces to command a certain number of the military to take the field against armies of locusts, with a train of artillery.

† Which is not the real egg, but the chrysalis of the ant, enveloped in its oval silken case.

colour still continued. Towards the end of June, they cast off their outward covering, and then it plainly appeared that they had wings, very like the wings of bees, but as yet unripe, and unexpanded; and then their body was very tender, and of a yellowish green; then, in order to render themselves fit for flying, they gradually unfolded their wings with their hinder feet, as flies do; and as soon as any of them found themselves able to use their wings, they soared up, and by flying round the others, enticed them to join them; and thus their numbers encreased daily; they took circular flights of twenty or thirty yards square, until they were joined by the rest; and after miserably laying waste their native fields, they proceeded elsewhere in large troops. Wheresoever those troops happened to pitch, they spared no sort of vegetable: they eat up the young corn and the very grass; but nothing was more dismal than to behold the lands in which they were hatched; for they so greedily devoured every green thing thereon, before they could fly, that they left the ground quite bare.

"There is nothing to be feared in those places to which this plague did not reach before the autumn; for the locusts have not strength to fly to any considerable distance but in the months of July, August, and the beginning of September; and even then, in changing their places of residence, they seem to tend to warmer climates.

"Different methods are to be employed, according to the age and state of these insects; for some will be effectual as soon as they are hatched; others when they begin to crawl; and others in fine when they begin to fly; and experience has taught us here in Transylvania, that it would have been of great service to have diligently sought out the places where the females lodged; for nothing was more easy than carefully to visit those places in March and April, and to destroy their eggs, or little worms with sticks or briars; or if they were not to be beat out of the bushes, dung-hills, or heaps of straw, to set fire to them; and this method would have been very easy, convenient, and successful, as it has been in other places; but in the summer, when they have marched out of their spring quarters, and have invaded the corn-fields, &c. it is almost impossible to extirpate them without thoroughly threshing the whole piece of land that harbours them with sticks or flails; and thus crushing the locust with the produce of the land. Finally, when the corn is

ripe or nearly so, we have found, to our great loss, that there is no other method of getting rid of them, or even of diminishing their numbers, but to surround the piece of ground with a multitude of people, who might fright them away with bells, brass vessels, and all other sorts of noise. But even this method will not succeed till the sun is pretty high, so as to dry the corn from the dew; for otherwise they will either stick to the stalks, or lie hid under the grass; but when they happen to be driven to a waste piece of ground, they are to be beat with sticks or briars; and if they gather together in heaps, straw or litter may be thrown over them, and set on fire. Now this method seems rather to lessen their numbers than totally destroy them; for many of them lurk under the grass or thick corn, and in the fissures of the ground from the sun's heat: wherefore it is requisite to repeat this operation several times, in order to diminish their numbers, and consequently the damage done by them. It will likewise be of use, where a large troop of them has pitched, to dig a long trench, of an ell width and depth, and place several persons along its edges, provided with brooms and such-like things, while another numerous set of people form a semicircle that takes in both ends of the trench, and encompasses the locusts; and, by making the noise above mentioned, drive them into the trench, out of which if they attempt to escape, those on the edges are to sweep them back, and then crush them with their brooms and stakes, and bury them by throwing in the earth again. But when they have begun to fly, there should be horsemen upon the watch in the fields; who, upon any appearance of the swarm taking wing, should immediately alarm the neighbourhood by a certain signal, that they might come and fright them from their lands by all sorts of noise; and if tired with flying, they happen to pitch on a waste piece of land, it will be very easy to kill them with sticks and brooms in the evening or early in the morning, while they are wet with the dew; or any time of the day in rainy weather, for then they are not able to fly. I have already taken notice that, if the weather be cold or wet in autumn, they generally hide themselves in secret places, where they lay their eggs, and then die: therefore great care should be taken at this time, when the ground is freed of its crop, to destroy them before they lay their eggs. In this month of September, 1748, we received certain intelligence that several swarms of lo-

custs came out of Walachia into Transylvania through the usual inlets, and took possession of a tract of land in the neighbourhood of Clausberry, near three miles in length, where it was not possible to save the millet and Turkish wheat from these devourers. I am of opinion that no instance of this kind will occur in our history, except what some old men remember, and what we have experienced; at least there is no account that any locusts came hither which did not die before they laid their eggs: however this is a known fact; that about forty years ago, some swarms came hither out of Walachia, and did vast damage wherever they settled, but either left this country before the end of summer, or died by the inclemency of the weather."

As an appendix to the foregoing account, it is added by a correspondent from Vienna, that "a considerable number of locusts had also come within twenty leagues of that city, and that one column of them had been seen there, which was about half an hour's journey in breadth; but of such a length that, after three hours, though they seemed to fly fast, one could not see the end of the column."

We have before observed, that the locusts which fell in several parts of England, and in particular in the neighbourhood of the metropolis, in the year 1748, were evidently some straggling detachments from the vast flights which in that year visited many of the inland parts of the European Continent.

The ravages of locusts in various parts of the world, at different periods, are recorded by numerous authors, and a summary account of their principal devastations may be found in the works of Aldrovandus. Of these a few shall be selected as examples. Thus, in the year 593 of the Christian era, after a great drought, these animals appeared in such vast legions as to cause a famine in many countries. In 677, Syria and Mesopotamia were over-run by them. In 852, immense swarms took their flight from the eastern regions into the west, flying with such a sound that they might have been mistaken for birds: they destroyed all vegetables, not sparing even the bark of trees and the thatch of houses; and devouring the corn so rapidly as to destroy, on computation, an hundred and forty acres in a day: their daily marches or distances of flight were computed at twenty miles; and these were regulated by leaders or kings, who flew first, and settled on the spot which was to be

visited at the same hour the next day by the whole legion: these marches were always undertaken at sunrise. These locusts were at length driven by the force of the wind into the Belgic ocean, and being thrown back by the tide and left on the shores, caused a dreadful pestilence by their smell. In 1271, all the corn-fields of Milan were destroyed; and in the year 1339, all those of Lombardy. In 1541, incredible hosts afflicted Poland, Walachia, and all the adjoining territories, darkening the sun with their numbers and ravaging all the fruits of the earth.

2. *Crested Locust.*

Gryllus cristatus.—LINN.

THIS is one of the largest species of the tribe: being five or six times the size of the gryllus migratorius, and, together with some others of the larger kind, is made use of in some parts of the world as an article of food: they are eaten both fresh and salted, in which last state they are publicly sold in the markets of some parts of the Levant. The quantity of edible substance which they afford is but small, especially in the male insects; but the females, on account of the ovaries, afford a more nutritious sustenance. It is well known, that different interpretations have been sometimes given of the passage in the sacred writings in which John the Baptist is said to have fed on locusts and wild honey; and the word ακριδας has been supposed to mean the young shoots of vegetables rather than locusts; but, since the fact is established, that these insects are still eaten by the inhabitants of the east, there seems not the least reason for admitting any other interpretation than the usually received one. Why should we wonder that the abstemious prophet, during his state of solitary seclusion from the commerce of the world, should support himself by a repast which is to be numbered, not among the luxuries of life, but merely regarded as a substitute for food of a more agreeable nature? We may also adduce in support of this idea, the testimony of Hasselquist, who thus expresses himself on this very subject. "They who deny insects to have been the food of the holy man, urge that this insect is an unaccustomed and unnatural food; but they would soon be convinced of the contrary, if they would travel hither, to Egypt, Arabia, or Syria, and take a meal with the Arabs. Roasted lo-

custs are at this time eaten by the Arabs, at the proper season, when they can procure them; so that in all probability this dish has been used in the time of St. John. Ancient customs are not here subject to many changes, and the victuals of St. John are not believed unnatural here; and I was assured by a judicious Greek priest, that their church had never taken the word in any other sense; and he even laughed at the idea of its being a bird or a plant."

[*Hasselquist's Travels, Engl. Trans. p.* 419.

The gryllus cristatus above-mentioned is a highly beautiful animal; being of a bright red, with the body annulated with black; and the legs varied with yellow: the upper wings tesseliated with alternate variegations of dark and pale green; the lower with transverse, undulated streaks: the length of the animal from head to tail is about four inches; and the expanse of the wings from tip to tip, when fully extended, hardly less than seven inches and a half. It is exquisitely figured in the works of Röesel.

3. *Domestic Cricket.*

Gryllus domesticus.—LINN.

This harmless and familiar little insect belongs,[1] from the peculiar form and structure of its wings, to the gryllus genus. It is an inhabitant of almost every house, and is found particularly about ovens and kitchen chimneys: it wanders about during the whole night, keeping up a continual chirping, especially before rain. It is said to forsake houses infested with the cock-roach; and is destroyed by pills or small masses of arsenic, and the fresh root of the daucus or carrot mixed with flour; or the root of the nymphæa boiled in milk.

4. *Mole Cricket.*

Gryllus gryllotalpa.—LINN.

Of all the British insects this is by far the most curious, and in its colour and manners differs greatly from the rest. It is of an uncouth, and even formidable aspect, measuring more than two inches in length; and is of a broad and slightly flattened shape,

of a dusky brown colour, with a ferruginous cast on the under parts, and is readily distinguished by the extraordinary structure of its fore-legs, which are excessively strong, and furnished with very broad feet, divided into several sharp, claw-shaped segments, with which it is enabled to burrow under ground in the manner of a mole: the lower wings, which, when expanded, are very large, are, in their usual state, so complicated under the very short and small upper-wings or sheaths, that their ends alone appear, reaching, in a sharpened form, along the middle of the back; the abdomen is terminated by a pair of sharp-pointed, lengthened, hairy processes, nearly equalling the length of the antennæ in front, and contributing to give this animal an appearance in some degree similar to that of a Blatta.

The mole-cricket emerges from its subterraneous retreats only by night, when it creeps about the surface, and occasionally employs its wings in flight. It prepares for its eggs an oval nest, measuring about two inches in its longest diameter: this nest is situated a hand's breadth below the surface of the ground: it is accurately smoothed within, and is furnished with an obliquely curved passage leading to the surface. The eggs are about two hundred and fifty or three hundred in number, nearly round, of a deep brownish yellow colour, and of the size of common shot: on the approach of winter, or any great change of weather, these insects are said to remove the nest, by sinking it deeper*, so as to secure it from the power of frost; and when the spring commences, again raising it in proportion to the warmth of the season, till at length it is brought so near the surface as to receive the full influence of the air and sunshine: but should unfavourable weather again take place, they again sink the precious deposit, and thus preserve it from danger. The eggs are usually deposited in the month of June or July, and the young are hatched in August. At their first exclusion they are about the size of ants, for which, on a cursory view, they might be mistaken; but on a close inspection are easily known by their broad feet, &c. In about the space of a

* This is affirmed by Goedart, but is disbelieved by Reaumur and Röesel; and it appears from experiment that the nest always requires to be kept in a moist situation; the eggs, if exposed to a dry air, being entirely shrivelled and destroyed.

month they are grown to the length of more than a quarter of an inch; in two months upwards of three quarters; and in three months to the length of more than an inch. Of this length they are usually seen during the close of autumn, after which they retire deep beneath the surface; not appearing again till the ensuing spring. During their growth, they cast their skin three or four times.

The mole-cricket lives entirely on vegetables, devouring the young roots of grasses, corn, and various esculent plants, an dcommits great devastation in gardens. It is found in most parts of Europe, and in the northern parts of Asia and America.

SECTION IV.

Chirping Grasshopper.

Cicada plebeja.—Linn.

This is the insect so often commemorated by the ancient poets, and so generally confounded by the major part of translators with the grasshopper. It is a native of the warmer parts of Europe, and particularly of Italy or Greece; appearing in the hotter months of summer, and continuing its shrill chirping during the greatest part of the day; generally sitting among the leaves of trees. These insects proceed from eggs deposited by the parent in and about the roots of trees, near the ground. They hatch into larves, which, when grown to their full size, are the tettigometræ of the ancient writers; and after having continued in this state of larva near two years, cast their skins, and produce the complete insect.

The ancients differ in their opinions relative to the cicadæ. Virgil speaks of them as insects of a disagreeable and stridulous tone*. On the contrary, Anacreon compliments them on their musical note, and makes the cicada a favourite of Apollo.

"Happy insect! blithe and gay,
Seated on the sunny spray,
And drunk with dew, the leaves among,
Singing sweet thy chirping song.

* Bucol. 2. &c.

All the various season's treasures,
All the products of the plains,
Thus lie open to thy pleasures,
Fav'rite of the rural swains.

On thee the Muses fix their choice,
And Phœbus adds his own.
Who first inspir'd thy lively voice
And tun'd the pleasing tone.

Thy cheerful note in wood and vale
Fills every heart with glee;
And summer smiles in double charms
While thus proclaim'd by thee.

Like gods canst thou the nectar sip,
A lively chirping elf;
From labour free, and free from care,
A little god thyself!"

There is also a very pleasing and elegant tale *, related by ancient authors, of two rival † musicians alternately playing for a prize; when one of the candidates was so unfortunate as to break a string of his lyre; by which accident he would certainly have failed; when a cicada, flying near, happened to settle on his lyre, and by its own note supplied the defective string, and thus enabled the favoured candidate to overcome his antagonist. So remarkable was the event, that a statue was erected to perpetuate the memory of it, in which a man is represented playing on a lyre, on which sits a cicada.

Notwithstanding these romantic attestations in favour of the cicada, it is certain that modern ears are offended rather than pleased with its voice, which is so very strong and stridulous that it fatigues by its incessant repetition; and a single cicada hung up in a cage has been found almost to drown the voice of a whole company.

It is to be observed that the male cicada alone exerts this power-

* See Antiq. mirab. narrat. lib. i. Strab. geogr. lib. 6.

† Viz. Eunomus of Locris, and Aristo of Rhegium.

ful note; the females being entirely mute: hence the old witticism attributed to that incorrigible sensualist, Xenarchus the Rhodian.

> "Happy the cicadas' lives,
> Since they all have voiceless wives!"

That a sound so piercing should proceed from so small a body may well excite our astonishment; and the curious apparatus by which it is produced has justly claimed the attention of the most celebrated investigators. Reaumur and Roësel in particular have endeavoured to ascertain the nature of the mechanism by which the noise is produced; and have found that it proceeds from a pair of concave membranes, seated on each side the first joints of the abdomen: the large concavities of the abdomen, immediately under the two broad lamellæ in the male insect, are also faced by a thin, pellucid, iridescent membrane, serving to increase and reverberate the sound, and a strong muscular apparatus is exerted for the purpose of moving the necessary organs.

The *cicada orni* has a near resemblance to the preceding species, and is by some naturalists regarded as a mere variety. They were certainly contemplated as the same species by the Greek and Roman writers. During the hottest part of the day in summer, the males, sitting among the leaves of trees, make a shrill and continual chirping; and so strong and stridulous is their note, that a single insect hung up in a cage has been found almost to drown the voices of a large company.

[*Shaw. Pantolog.*

SECTION V.

Camel-Cricket, or Praying Mantis.

Mantis oratorica.—LINN.

THIS is one of the most singular genera in the whole class of insects; and imagination itself can hardly conceive shapes more strange than those exhibited by some particular species.

The chief European kind is the *mantis oratoria* of Linnæus, or camel-cricket, as it is often called. This insect, which is a stranger to the British isles, is found in most of the warmer parts of Europe, and is entirely of a beautiful green colour. It is nearly three inches

in length, of a slender shape, and in its general sitting posture is observed to hold up the two fore-legs, slightly bent, as if in an attitude of prayer: for this reason the superstition of the vulgar has conferred upon it the reputation of a sacred animal, and a popular notion has often prevailed, that a child or traveller having lost his way, would be safely directed by observing the quarter to which the animal pointed when taken into the hand. In its real disposition it is very far from sanctity; preying with great rapacity on any of the smaller insects which fall in its way, and for which it lies in wait with anxious assiduity in the posture at first mentioned, seizing them with a sudden spring when within its reach, and devouring them. It is also of a very pugnaceous nature; and when kept with others of its own species in a state of captivity, will attack its neighbour with the utmost violence, till one or the other is destroyed in the contest. Roësel, who kept some of these insects, observes that in their mutual conflicts their manœuvres very much resemble those of hussars fighting with sabres; and sometimes one cleaves the other through at a single stroke, or severs the head from its body. During these engagements the wings are generally expanded, and when the battle is over, the conqueror devours his antagonist.

Among the Chinese this quarrelsome property in the genus mantis is turned into a similar entertaiment with that afforded by fighting cocks and quails: (for it is to this insect, or one closely allied to it, that I imagine the following passage in Mr. Barrow's account of China to allude.) "They have even extended their enquiries after fighting animals into the insect tribe, and have discovered a species of gryllus, or locust, that will attack each other with such ferocity as seldom to quit their hold, without bringing away at the same time a limb of their antagonist. These little creatures are fed and kept apart in bamboo cages, and the custom of making them devour each other is so common that, during the summer months, scarcely a boy is to be seen without his cage of grasshoppers."

[*Shaw. Barrow.*

SECTION VI.

Cochineal, Kermes, and Gum-Lac Insects.

Coccus.—LINN.

THESE all belong to one common genus, which exhibits various peculiarities, but particularly that of having the males possessed of four wings, and the females apterous or wingless; the males, moreover, being much smaller than the females.

1. *Cochineal Insect.*

Coccus cacti.—LINN.

This is the most important of the whole fraternity, and is celebrated for the beauty of the colour which it yields, when properly prepared. This species is a native of South America, and is pecuIiarly cultivated in the country of Mexico, where it feeds on the plants called cactus cochenillifer, and cactus opuntia. The female officinal cochineal insect, in its full-grown pregnant or torpid state, swells or grows to such a size, in proportion to that of its first or creeping state, that the legs, antennæ, and proboscis are so small, with respect to the rest of the animal, as hardly to be discovered except by a good eye, or by the assistance of a glass; so that on a general view it bears as great a resemblance to a seed or berry as to an animal. This was the cause of that difference in opinion which long subsisted between several authors; some maintaining that cochineal was a berry, while others contended that it was an insect. We must also here advert to another error; viz. that the cochineal was a species of coccinella or lady-bird. This seems to have taken its rise from specimens of the coccinella cacti of Linnæus being sometimes accidentally intermixed with the cochineal in gathering and drying.

When the female cochineal-insect is arrived at its full size, it fixes itself to the surface of the leaf, and envelopes itself in a white cottony matter, which it is supposed to spin or draw through its proboscis in a continued double filament, it being observed that two filaments are frequently seen proceeding from the tip of the proboscis in the full-grown insect.

The male is a small and rather slender dipterous fly, about the size of a flea, with jointed antennæ and large white wings in proportion to the body, which is of a red colour, with two long filaments proceeding from the tail. It is an active and lively animal, and is dispersed in small numbers among the females, in the proportion, according to Mr. Ellis, in the Philosophical Transactions, of about one male to a hundred and fifty, or even two hundred females. When the female insect has discharged all its eggs, it becomes a mere husk, and dies; so that great care is taken to kill the insects before that time, to prevent the young from escaping, and thus disappointing the proprietor of the beautiful colour. The insects when picked or brushed off the plants, are said to be first killed either by the fumes of heated vinegar, or by smoke, and then dried, in which state they are imported into Europe; and it is said that the Spanish government is annually more enriched by the profit of the cochineal trade than by the produce of all its gold mines.

It may perhaps be almost unnecessary to add, that, exclusive of the general or large scale in which cochineal is used by the dyers, the fine colour so much esteemed in painting, and known by the name of carmine, is no other than a preparation from the same substance, and is unquestionably the most beautiful of all the pictorial reds. It is also used, when properly mixed with hair-powder, powdered talc, &c. in that innocent cosmetic, so much used by the ladies, and popularly known by the French term rouge.

2. *Kermes, or Scarlet-dye Insect.*

Coccus ilicis.--Linn.

The female of this species adheres in its advanced or pregnant state to the shoots of the quercus coccifera (Ilex aculeata cocciglandifera. C. Bauh. pin.), under the form of smooth reddish-brown or blackish powdery grains or balls, of the size of small peas. The tree or shrub grows plentifully in many parts of France, Spain, Greece, and the islands of the Archipelago. The cocci are found adhering in groupes of five, six, or more together, or pretty near each other. They are gathered for the purpose of commerce by the country people.

Before the discovery of America, the coccus ilicis or kermes, as it was then termed, was the most valuable substance for dyeing

scarlet, and was collected in great quantity for that purpose. According to the mildness or severity of the winter, the harvest of the kermes is said to be more or less plentiful; and it is no very uncommon thing to have two harvests in a year. Before dying, the berries or dormant insects are steeped in vinegar, to prevent the exclusion of the young animals by thus killing the parents. They are then spread or thrown on linen, and as long as they continue moist are turned twice or thrice a day, to prevent their heating, and are afterwards put up for sale.

Woollen cloth dyed with kermes was called scarlet in grain; the animal having been popularly considered as a grain: the colour is a durable, deep-red, called ox-blood colour, much inferior to the brilliancy of cochineal scarlet, but far more lasting, and less liable to stain. Mons. Hellot, in his *Art de Tendre*, observes that the figured cloths to be seen in the old tapestries of Brussels and the other manufactures of Flanders, which have scarcely lost any thing of their liveliness by standing for two hundred years, were all dyed with this ingredient.

3. *Gum-lac Insect.*

Coccus ficus.—LINN.

The body of this insect is of a red colour, the antennas branched, the tail two-bristled. It is found on the ficus religiosa and indica (the banian tree); and produces the gum-lac of the shops. It is about the end of January that the female fixes herself, in consequence of pregnancy, to the succulent extremities of the young branches, and becomes torpid. She now secretes, apparently from the edges of the antennas, limbs, and setæ of the tail, a spissid, pellucid liquor by which it becomes enveloped; and it is this secretion which forms the gum-lac: yet as a gum very nearly resembling it is obtained from the plaso, and various other trees on which this insect fixes, by making incisions through their bark, it should seem that the secreted gum is an unchanged vegetable, rather than an animal production. It is in the cells of this viscid matter that the female deposits her eggs. In March the different cells are completely formed; in November we find about twenty or thirty oval eggs, or rather young grubs occupying them, and apparently supported by the fluid they contain. When this fluid is all expended, the

young grubs pierce a hole through the back of the mother, and walk off one by one, leaving their exuviæ behind, which is that white, membranous substance found in the empty cells of the stick-lac. The lac is of a deep red colour, and is the colouring material employed in the best sealing-wax, as well as in a variety of other articles of common use.

[*Shaw. Pantolog. Phil. Trans.*

SECTION VII.

Lady-bird. Lady-cow.

Coccinella septem-punctata.—LINN.

OF the coccinella genus there are not less than a hundred and sixty-four known and described species, feeding chiefly on plant-lice, particularly the vine-fretter or aptis, and hence highly serviceable in clearing vegetables of the myriads with which they are often infested. It is the *seven-dotted* coccinella that passes under the familiar name of lady-bird, or lady-cow. The shells are red, the seven dots black. It inhabits Europe generally, and is said, like several other insects of the order coleoptera, to have the singular property of giving immediate and effectual relief in the most violent paroxysms of tooth-ach, by rubbing them between the thumb and finger to the affected tooth. It proceeds from a larva of disagreeable appearance, of a lengthened oval shape, with a sharpened tail of a black colour, varied with red and white specks, and of a rough surface: it resides on various plants, and changes to a short, blackish, oval chrysalis, spotted with red, which is metamorphosed to this beautiful insect in the month of May and June.

[*Turton. Pantolog.*

SECTION VIII.

Butterfly.

Papilio.—LINN.

THIS curious insect is distinguished by its antennas growing thicker towards the tip, and generally ending in a knob; wings, when sitting, erect, the edges meeting together over the abdomen: flies in the day time. Very nearly twelve hundred species scat

tered over the globe; of which nearly seventy are natives of our own country.

This genus is so extremely voluminous, that it has been judged necessary by every entomologist to divide it into sections and sub-sections. Fabricius has, upon this subject, been not only more minute, but more fortunate than Linnæus. We shall therefore copy the arrangement of both.

Linnæan Division.

A. Equites. Upper wings longer from the posterior angle to the tip than to the base; antennas often filiform.

α. Trojans. Generally black; with sanguineous spots on the breast.

ϐ. Greeks. Breast without sanguineous spots; an ocellate spot at the angle of the tail.

† Wings without bands.

†† Wings with bands.

B. Heleconii. Wings narrow, entire, often naked or semitransparent; the upper ones oblong, the lower ones very short.

C. Danai. Wings very entire.

α. Candidi. Whitish wings.

ϐ. Festivi. Variegated wings.

D. Nymphales. Wings denticulate.

α. Gemmati. Wings with ocellate spots.

† On all the wings.

†† On the upper wings only.

††† On the lower wings only.

ϐ. Phalerati. Wings without ocellate spots.

E. Plebeji. Small: the larve often contracted.

α. Rurales. Wings with obscure spots.

ϐ. Urbicolæ. Wings mostly with transparent spots.

Fabrician Division.

I. Papilio. Feelers reflected; tongue exserted, spiral; antennas thicker towards the tip.

A. Upper wings longer from the posterior angle to the tip than to the base.

α. Equites. Lower wings cut to admit a free motion of the abdomen.

† Trojans. Generally black; with sanguineous spots on the breast.

†† Greeks. Breast without sanguineous spots; an ocellate spot at the angle of the tail.

β. Satyri. Lower wings dilated on the inner margin, into a groove for the reception of the abdomen.

B. Heleconii. Wings oblong, the lower ones short and rounded.

C. Parnassii. Wings rounded, entirely, or partially naked.

D. Wings rounded.

α. Festivi. Lower wings distant at the inner edge.

β. Danai. Lower wings meeting at the inner edge and covering the base of the abdomen.

γ. Nymphales. Lower wings forming a groove for the reception of the abdomen.

II. Hesperia. Feelers compressed and hairy at the base, the tip cylindrical and naked; club of the antennas oblong and often hooked.

α. Rurales. Wings with obscure spots.

β. Urbicolæ. Wings with mostly transparent spots.

These insects feed on the nectar of flowers, and the moisture exsuding from trees; the larves are active, and furnished with tentacles and sixteen feet; they are sometimes spinous and sometimes naked, and feed voraciously on the leaves of various plants; the pupe is naked, quiescent, and attached to trees or other substances, by filaments either from the tip or the middle.

There is no tribe of insects that has been more accurately examined, or whose history has been so fully detailed. Reaumur and Fabricius are the naturalists to whom we are chiefly indebted for our knowledge of its extensive numbers, and very curious powers.

Some of the species frequently cast their skin, besides undergoing those more considerable transformations which introduce them into a new sphere of action. Before the fresh tunic is developed, the outer skin is seen to wither and lose the vivacity of its colours, owing to the new coat which already covers the animal beneath, and intercepts the juices which formerly circulated through it: after some efforts this dried covering is rent towards the back part of the head, where the fresh skin appears; and through this aperture the worm makes his escape, leaving his spoils behind.

After undergoing several changes of this kind, the insect prepares to undergo another and still more considerable, which is to introduce it into the state of chrysalid, deprived of almost all motion, and incapable of taking food. The change is effected nearly in the same manner as the foregoing; but in some it is very long in being accomplished. Several species of the butterfly worm construct in a very ingenious manner a coque, or cocoon, or nut of silk, into which they enter before their transformation, and in which they continue for nine months, without food, before their metamorphoses be accomplished. During this long period they are apparently inanimate, and take no nutriment.

Various substances enter into the composition of the habitations constructed by these animals before their metamorphoses: some are of silk; in some, silk is combined with other matters; several kinds construct no habitation, but are protected by a crustaceous shell, formed by a glutinous substance, exsuding from their bodies: some are suspended vertically, while others hang horizontally by a thread which surrounds the middle of the body.

The external form of the chrysalids varies according to the species of butterfly that inhabits them; in all, however, there are apertures opposite to the thorax, by which respiration is carried on during the whole period of their inactive state. After the appointed time, when the animal has acquired sufficient vigour, the shell is broken, which at once constituted the grave of the caterpillar and the cradle of the butterfly: the down already grown upon the insect has completely separated it on all sides from the shell, which by the action of the head is broken opposite to that part, and affords free egress to the prisoner it so long confiued.

The wings of the butterfly, on its first appearance, are close folded; but by the help of a liquor constantly circulating through them they are soon expanded, and sufficiently hardened by the action of the air, to endure the efforts of flying. It is then that the insect enters upon a more enlarged sphere of action, with increased powers: he ranges from flower to flower, darting his rostrum into their nectaries for the delicious stores they contain. Then too in the full possession of every faculty granted to his race, he prepares to multiply and perpetuate it.

This last and most considerable metamorphosis is attended with

a greater change in the economy of the animal than any of the preceding; for not only the skin, but the teeth, jaws, and even the cranium, are left behind. The large artery which passes along the body may be considered as a succession of different hearts employed in circulating the blood, which is at that important æra observed to flow in a different direction from what it did before, like the fœtus of a quadruped after birth: formerly it circulated from the extremity to the head; it now pursues a course directly opposite.

The quantity of food taken by these animals in their last state is comparatively small to what they antecedently devoured. For a short time after their appearance on the wing, their excrements are voided in a greater quantity, and are red like blood; this is, perhaps, the remains of that food which they contained before their late change. The appearance of this substance on the surface of the earth has at different times been regarded as portentous of some heavy calamity, being supposed to be blood that had dropt from the clouds.

Some of these animals are gregarious, and live in society during every stage of their existence; others live in that state during one period of their existence only. The duration of their life is various, according to the weather; its warmth accelerates every step of its progress, and its cold retards all their developments: a worm produced in an early part of the summer lives only for three months; while the same species, if hatched a little later in the season, lives another year; hence Reaumur has devised a method of prolonging the lives of these animals greatly beyond their natural course.

The butterflies of every species are extremely prolific; a single female at one birth produces several hundred eggs: and one of the most wonderful particulars in the history of these insects, is the precaution with which they provide for the security of their young; some species tear off even the down from their own bodies to supply them with a covering.

Various insects prey upon the butterfly, or hasten the approach of its dissolution. One or two species of ichneumon perforate the body of the insect while a caterpillar, and there deposit their eggs; and, although the caterpillar continues to live, and is metamor-

phosed into a chrysalid, no butterfly is produced from it, those internal parts that were essential to its perfection being consumed by the larves of the ichneumon. From the great fecundity and variety of the insects of this genus, they probably would soon cover the surface of the earth, did not nature provide a bar to their increase by multiplying their enemies: hence they are destined to become food to a great number of animals of various kinds, some of which swallow them entirely, others macerate their bodies; while many accomplish their destruction by gradually sucking their juices. A single pair of sparrows, in order to supply themselves and their young, may destroy, it has been calculated, three thousand three hundred and sixty butterflies in one week.

The variety and richness of the colours that adorn the greater part of this tribe, have made it an object of especial research by painters as well as by naturalists. In general the tropical climates that heighten the colours both in the plumage of birds, and the scales of fishes, offer the most gaudy specimens of the butterfly.—We have only space to detail an example or two.

1. P. Priamus. Wings indented, silky; upper pair above green with a black disk and edge; lower ones with from four to six black spots; thorax black, with three green spots: this insect measures more than six inches from wing's end to wing's end; the black is of a velvet softness, the silky wings peculiarly lustrous, and the green of the upper pair of the most beautiful grass hue. Linnæus regarded it as the most superb of the whole papilionaceous tribe. It is a native of Amboyna, and very rare. It arranges under the section Equites, Troes, or Trojans.

2. P. Hector. Wings tailed black, both surfaces of the same colour; the upper pair with an interrupted white band, lower ones with numerous crimson spots: head and upper margin of the thorax red. This, also, as its specific name imports, belongs to the same section, and is very appropriately named. It is a native of Asia, and highly beautiful.

3. P. machaon. Wings tailed, both surfaces alike, yellow with a brown border, in which are yellow lunules; angle of the tail fulvous. This is one of the very few of the section Equites that are natives of our own country. It is commonly known among collectors of this tribe of insects by the name of the *swallow-tailed* butterfly, and is a very elegant species. It is generally found in

the month of August on umbelliferous plants. The larve is solitary and glabrous; furnished with tentacles, annulate with black and green, and dotted with red; the pupe is yellowish.

4. P. Apollo. Wings entire, white, spotted with black; lower ones with four eyes above, and six beneath. This is also a beautiful insect, somewhat larger than our great cabbage butterfly; it inhabits Europe, and has been occasionally found in our own gardens. It belongs to the section Parnassii. The larve is solitary, furnished with tentacles, silky, black, with two red dots on the segment on each side; pupe slightly folliculate, ovate, blueish, with red dots on each side on the fore-part.

5. P. Brassicæ. Common large white, or cabbage butterfly. Wings rounded entire, white: tip of the upper pair brown, and (in the male) two brown spots. Inhabits Europe, and is known to every one. Larve cinereous, dotted with black, with three sulphur lines; tail black; pupe pale-green, with three yellow lines, and three globular segments. A species of the Danai section.

P. Io. Peacock butterfly. Wings angular, indented, fulvous, spotted with black, and a large blue eye in each, An elegant specimen, inhabiting Europe and our own country. It belongs to the division nymphales. The larve is spinous, black, dotted with white, legs ferruginous: pupe ten-toothed, green with gold-dots, bifid behind.

7. P. Iris. Wings indented, brown with a blue gloss, and whitish interrupted band on each side; all with a single eye; the eyes on the upper pair above blind. Found in our own gardens and in Europe generally: belongs also to the nymphales. The male is spotted with white on the upper wings, and is without the eye. The larve is green with two horns, and oblique pale lines; pupe greenish, bifid at the tip.

[*Linn. Fabricius. Turton. Pantolog.*

SECTION IX.

Moth. Silk-Worm.

Phalena.—LINN.

IN this genus of insects the antennas are found gradually tapering from the base to the tip: the tongue is spiral; there is no jaw, and the wings, when at rest, are generally deflected; flight nocturnal. Sixteen hundred species. These fly abroad only in the evening, and during the night, and feed on the nectar of flowers: the larve is active and quick in motion, mostly smooth, more or less cylindrical, and preys voraciously on the leaves of various plants: pupe quiescent, more or less cylindrical, pointed at the tip or at both ends, and is generally inclosed in a follicle. They are divided into the following sections:

A. bombyx. Antennas filiform; feelers two, compressed, reflected; tongue short, membranaceous, obtuse, bifid; larve sixteen-footed, often hairy; pupe pointed at the tip. These are subdivided again:

α Wings expanded.
β Wings reversed.
γ Wings deflected.
δ Wings incumbent.
ε Wings convolute.

B. geometra. Antennas filiform; feelers cylindrical; tongue projected, membranaceous, setaceous, bifid; larve eight or ten-footed; six of the feet pectoral, two caudal, and sometimes two subcaudal; pupe pointed at the tip. Thus again subdivided:

α Antennas pectinate.
β Antennas setaceous.
γ Wings forked, connivent.

C. noctua. Antennas setaceous; feelers compressed, hairy, the tip cylindrical and naked; tongue projecting, horny, setaceous, bifid; larve sixteen-footed; pupe pointed at the tip. Subdivided as follows:

α Wings expanded.

ϐ Wings flat, incumbent; thorax smooth.

γ Wings flat, incumbent; thorax crested.

δ Wings deflected; thorax smooth.

ε Wings deflected; thorax crested.

D. hyblœa. Antennas setaceous; feelers projecting, compressed, dilated in the middle; lip projecting, acute.

E. hepialus. Antennas moniliform; feelers two, reflected, hairy, between them is the rudiment of a bifid tongue; larve sixteen-footed, that feed on the roots of plants; pupe folliculate, cylindrical, and pointed at the tip.

F. cossus. Antennas short, filiform; feelers two, very short, cylindrical, reflected; without spiral tongue.

G. pyralis. Antennas filiform; feelers two, equal, naked, cylindrical at the base, the middle dilated into an oval, and subulate at the tip; tongue projected, setaceous, bifid; wings very obtuse, and slightly curved at the exterior margin; larve sixteen footed, rolling up the leaves to which it attaches itself.

H. tinea. Antennas setaceous; feelers four, unequal; larve found in houses, among linen and woolen cloths and furniture, in which it eats holes, and to which it is very destructive.

I. allucita. Antennas setaceous; feelers two, divided to the middle, the inner division very acute.

K. pterophorus. Antennas setaceous; feelers two, linear, naked; tongue exserted, membranaceous, bifid; wings fan-shaped, divided down to the base, and generally subdivided as far as the middle; larve sixteen-footed, ovate, hairy; pupe naked, subulate at the tip.

The greater part of this numerous tribe, when at liberty in the fields, only fly during the night, or towards the evening: when domesticated in boxes made for that purpose, they give indications, by their fluttering within, when the natural period of their activity approaches. During the day they remain quiet, and apparently reconciled to their confinement; they flutter throughout the whole extent of their prisons towards the close of day, and testify their impatience at their want of freedom.

All the butterflies are provided with a rostrum for gathering, and for the reception of their food; a great part of the moths are entirely destitute of such an organ, while in others it is so small

as scarcely to be discernible with the naked eye. This singular fact hath been fully investigated by the indefatigable Reaumur, who, after examining many moths, with a strong magnifier, has not been able to trace the smallest vestige of a mouth. A considerable number, therefore, of these animals must pass the whole of their winged state without food; nor can they be destructive to vegetable or animal substances, except while they remain in the form of worms.

The larves or caterpillars from which the various species of moths are produced, exhibit nearly the same variety of appearance as the winged insects which spring from them. Some are large, while others are extremely minute; many are provided with ten, others twelve and fourteen feet; the largest and most common have sixteen. Some of the smaller caterpillars are smooth, and others covered with hairs, which produce an itching and an inflammation when they touch the human skin.

All the caterpillars of phalænæ, after having several times cast their skin, spin for themselves the materials of a habitation, in which they are to be transformed into chrysalids. Of all the inventions of insects to protect themselves during this state of imbecility, that practised by the silk-worm is most universally known; and if animals acquire a consequence or reputation from their connection with man, and the conveniences with which they accommodate him, this insect may challenge, perhaps, a larger share of it than any other animal whatever. Our luxury has brought silk into such general request, that it may now be deemed a necessary of life: the poor, in some countries at least, would find it almost impossible to procure the necessary articles of clothing, were woollen stuffs worn by all those who at present are supplied with silk.

The produce of the phalæna mori, or common silk-worm, has been found most proper for the purpose of manufacturing. That glutinous substance with which the silk of this species is always covered, when it first comes from the worm, and which gives it that adhesive quality so proper for constructing their edifices, sooner dries than in that of any other insect. The cods constructed by some other species are so firmly glued together, that no operation can separate the threads. The produce of many is

by far too fine for any purpose in our manufactories, while that of another class is too coarse.

Several very laudable attempts have been made, but hitherto without any considerable degree of success, to rear the silk-worm in Britain. The public have been informed, by a manufacturer, of Paisley, of his having prepared a web entirely of the silk produced by worms of his own rearing. And in the Transactions of the Society for the encouragement of arts, manufactures, and commerce, a number of very useful experiments are recorded with regard to the food and management of these insects.

Probably the want of a sufficient number of mulberry trees has hitherto rendered ineffectual the efforts of our countrymen to introduce and rear any considerable quantity of silk-worms. From the attempts that have already been made, it appears, that the white mulberry is preferable to the black, in feeding; and that the latter is to be preferred to the lettuce. Twelve cocoons, the produce of worms fed upon the white mulberry, weighed seven penny-weights two grains; while an equal number of those that had been fed upon the black mulberry weighed only six penny-weights three grains; six penny-weights were obtained from the same number of worms fed upon common lettuce.

Endeavours to produce raw silk in our own country seem the more worthy of encouragement, as we appear to possess some advantages of which Italy and many other silk countries are destitute. In Italy the chrysalids so soon come to life, that it is necessary to destroy them, lest, by eating their way out, they should injure the silk. In order to effect this, they are collected and placed in heated ovens, where again the silk, without singular caution, is apt to be damaged. In our own climate, where every progression of the insect tribe is slower, there is sufficient time to wind off the silk without killing the chrysalis.

But beside the injury that may be done to the silk in Italy, from the length of time which it is necessary to keep the chrysalites in these ovens, they are there obliged to suffer the moth to eat its way out of the largest cones, in order to have eggs from the most vigorous and healthy. Hence they lose all the silk of these cones, which, in our own country, might be gathered while the moths are preserved. Thus we seem to possess two striking advantages,

which may probably compensate for the want of others which our climate has denied us.

Yet our climate itself is in some respects superior to those where silk is raised. In the south of France the frosts are often so intense as to kill the mulberry leaves after they are out. At that season of the year, this is seldom the case in England; which is also more free from lightning, and those sultry heats that have always been deemed prejudicial to the silk-worm. From such considerations, the time may perhaps arrive when our countrymen, by farther knowledge and experience, may be enabled to avail themselves of these exclusive advantages, and become entitled to a rank as distinguished among the raisers, as that which they have long held among the manufacturers of silk.

The silk-worm, however, is far from being the only insect of whose labours man might probably avail himself. There are many species very common, and immensely fertile, that might be beneficially employed in procuring silk, did we know how to profit of their labours. M. de Reaumur has mentioned several whose productions deserve a trial, although we are aware that the silk of many of them is altogether unfit for our purposes; their coques being not only coarse, but so scantily provided with silk, that the animal is obliged to join dry leaves, bits of wood, and other materials, in order to give stability to its edifice. Some of them indeed spin under ground, and their work consists only of joining and connecting together, by means of their threads, different particles of earth, of which their house is composed. These caterpillars, when kept by the naturalist, who waits for their perfect form, must be supplied with earth in the boxes in which they are lodged; otherwise they will perish, from not being able to construct an edifice fit for their reception.

The moths differ from the butterflies, in remaining in their chrysalid state for a much longer period before their metamorphoses into perfect insects are completed. Their form, too, is then different, being oblong, and not angular, like the chrysalid of the butterfly. Some remain in their coques for several years successively; especially if a cold damp situation have retarded their progress. So great is the effect of heat in precipitating their developments, that a moth in a warm exposure may be produced from its chrysalid, even in the depth of winter.

After the phalænæ issue from their last covering, some of them are destitute of wings: these are the females of certain kinds, who, instead of wings, have only short protuberances, altogether unfit for the purpose of flying. They have the appearance of large creeping animals of a different order, and can only be recognised for moths by the shape of their antennas, which are similar to those of the males, and by those scales with which the body of these animals is covered.

Though the moths do not in general fly by day, yet it is the light which, at evening, attracts them into the dwellings of man: then it is that they are seen entering the rooms, and fluttering around the candles, where they often meet with a painful death. This fondness for light has suggested to the curious a method of catching moths, by carrying a lantern into a bower, around which they all flock, when the greater part may be led into captivity.

Out of this almost innumerable tribe of insects we can select but a few specimens.

1. P. mori. Common silk-worm. Wings pale, with three obsolete brown streaks. We have already made some observations on the produce of this curious moth, and have now only to remark, that in its native state it inhabits China, on the mulberry tree, whence its specific name, and was introduced into Europe in the reign of the emperor Justinian: it is the fine silky threads which compose the follicle of the pupe, that are converted into that valuable article of commerce and luxury, in our own country denominated silk. This species belongs to the partition bombyx: the larve is characterised by having the tail naked and whitish; the pupe is folliculate, reddish-brown.

2. P. atlas. Wings foliate, varied with yellow, white, and ferruginous, with a transparent spot on each, that on the upper pair with a contiguous smaller one. This is the largest and most splendid of all the phalænæ yet known: the extent of its wings measures not less than eight inches and a half. It is a native of both the Indies; and occasionally varies in size and colours. It belongs to the partition bombyx: the larve is verticillate, with hairy tubercles, and spins a web of very strong yellowish silk.

3. P. luna. Wings tailed, both surfaces alike; colour elegant pea-green, with a transparent lunule eye on each wing; the upper

wings have a dark-brown rib, which extends across the thorax; body covered with white wool. It inhabits North America.

4. P. pavonia. Wings rounded, clouded with grey and barred with grey beneath, each of them with a nictitant semitransparent eye. The most beautiful European insect of the bombyx partition: its wings, when extended, measure about six inches. It is subject to several varieties in its size, and the disposition of its markings; the larve is gregarious and green, verticillate with red or yellow hairy protuberances; pupe blackish, folliculate, with an elastic aperture at the rib. It is occasionally found in our own country.

5. P. sambucaria. Wings tailed, angular, yellowish, with two darker streaks; lower ones with two reddish dots at the tip. It is an elegant moth, of a pale sulphur colour, found in June and July, on the leaves of the elder-tree, whence its specific name. Its chrysalis is black, and may be readily traced in the month of May in the same situation. It belongs to the partition geometra.

6. P. vestianella. Cloth-moth. Wings cinereous with a white rib, the tips ascending and feathered. This insect belongs to the tinea division, and is the common moth found in cloths and woollen furniture, and so destructive to them.

7. P. sarcitella. Wings cinereous, thorax with a white dot on each side. This also belongs to the division tinea, and is found in skin-cloths and woollen furniture; to which, like the last, it proves terribly destructive.

These moths construct the abode in which they reside of the grains of wool, or other materials, which they gnaw off. Their food is of the same substance; and what greatly increases the extent of their devastations is, that every step they advance upon cloth, feeling themselves incommoded by the wool in their way, they gnaw a smooth passage for themselves, like a man with a scythe in his hand, cutting down the grass of the meadow as he proceeds. Hence these species are among the most destructive of the tribe. The most costly articles of fur are those which are not worn every day; and for this very reason they are most exposed to their attacks. The methods for preventing their devastations may be reduced to the two following; either we must destroy the insects, or render our clothes disagreeable food for them. The insects may be destroyed by oil, or the fumes of tobacco; and the

materials may be rendered nauseous to them, and thus escape their ravage, by having intermixed with them fragments of Russia leather, or other skins, that emit and retain a strong animal odour; and it is probably on this account, though the odour is far less powerful, that this insect never commits its depredations on wool while on the back of the sheep.

8. P. pentadactyla. Body and wings snowy; upper part bifid, lower ones three-parted. A very beautiful European species, a native of our own country, and of other parts of Europe; size minute; the wing divided apparently into plumes, the upper by a delicate midrif consisting of two, the lower of three, with innumerable lateral fibres. The larve is sixteen-footed, hairy, green, with black dots, and a white dorsal line; pupe hairy-green, dotted with black. This insect belongs to the division pterophorus, which constitutes a part of the alucita of Gmelin.

9. P. hexadactyla. Wings cleft, cinereous, spotted with brown, all of the six-parted. This also belongs to the division pterophorus: it inhabits England, and Europe generally, and is found on the loriscera xylosteum, or honey suckle; and is likewise a most elegant and beautiful insect. It often appears before our windows, and flies in, when they are open, in a still and warm evening in September.

SECTION X.

May-Fly.

Ephemera vulgata.—Linn.

The ephemera genus exhibits a wonderful difference between the same animal in its larva state, and that of its ultimate or perfect state; the larva being altogether aquatic, the complete insect aërial. It also affords an example of what may be termed a flying pupa; since, in some species at least, the insect is no sooner evolved from the larva than it flutters to the nearest convenient spot, and again shifts its pellicle*, the wings themselves having cast their exterior membrane. The ephemeræ are extremely

* This operation is so quick that it may be rather called springing from the chrysalis than gradually emerging.

short-lived insects. The most familiar species is the ephemera vulgata, or common May-fly, so plentiful in the early part of summer, about the brinks of rivulets and stagnant waters. It is of a greenish brown colour, with transparent wings, elegantly mottled with brown, and is furnished at the extremity of the body with three very long black bristles. It flutters during the evening about the surface of the water, but during the day is generally seen in a quiescent posture, with the wings closed, and applied to each other in an upright position. The larva is of a lengthened shape, about an inch in length, furnished along each side of the body with several finny plumes, and at the tail with three long feathered processes: it has also a pair of moderately long antennæ, though those of the complete insect are extremely short. When arrived at its full size, as above-described, it exhibits the rudiments of wings on the back, in the form of a pair of oblong sheaths or scales: its colour is a pale yellowish or whitish brown. It is supposed to continue two years in this state of larve before it changes into the complete insect. This change takes place in the evening, when the larva rises to the surface of the water, and soon divesting itself of its skin, flies to some neighbouring object; and after having remained some time longer, again casts its pellicle, and appears in its ultimate or perfect form, in which, as well as in its larva state, it is a favourite food of several kinds of fishes, and particularly of the trout. In some seasons it is extremely plentiful, the air in the immediate neighbourhood of its natal waters being frequently blackened by its numbers during the evening hours. We are assured by Scopoli, that such swarms are produced every season, in the neighbourhood of some particular spots in the neighbourhood of Carniola, that the countrymen think they obtain but a small portion, unless every farmer can carry off about twenty cart-loads of them into his fields, for the purpose of a manure.

But, of all the European ephemeræ, that which has been most celebrated, and of which almost every reader must recollect the general and superficial account, so often detailed in works of natural history, is the species described by Swammerdam *. It is of a white colour, with the anterior rib of the upper wings black,

* Ephemera horaria??—Linn.

or deep brown, and the tail is furnished with two long bristles. This insect, which is common in many parts of Europe, is commemorated as a most remarkable instance of the brevity of animal life; since after its change into the perfect animal it survives but a very few hours, perishing in the course of the same evening that gave it birth. It is to be recollected, however, that its larva lives in its aquatic state two, and even sometimes nearly three years; and is in this state so tenacious of life that Swammerdam assures us, that one which he pierced with a pin, to a board, in order to preserve it, lived all the next day notwithstanding. According to the figure given by Swammerdam, it is extremely allied to the larva of the ephemera vulgata; residing chiefly in tubular cavities, which it forms in the mud or clay of the waters it inhabits, occasionally coming out in quest of food. In this respect it agrees with the larvæ of several others of this genus, which have a similar habit of forming tubular hollows in the banks of their native waters. When arrived at full growth, the larva, or, more properly, pupa, rises, like that of the common ephemera, to the surface of the water, generally between the hours of six and seven in the evening; and the skin of the back cracking, and springing off with an elastic motion, the fly is almost instantaneously evolved, as in the common species; after which it flies to the nearest convenient spot, and again divesting itself of its pellicle, appears in its perfect or ultimate state. It now flies again to the water, and fluttering over its surface, as if sporting with its innumerable companions, enjoys all the pleasures of its short remainder of existence: the female breeds, deposits her eggs, and, like the male, perishes before, or with the dawn of the approaching day.

This species, according to Swammerdam, is extremely frequent in the mouths or entrances of the Rhine, the Maes, the Wael, the Leck, and the Isel. It appears in the fly or perfect state about midsummer, and the season of its appearance lasts only three days, none being seen again till the following year.

[*Swammerdam. Shaw.*

SECTION XI.

Gnat. Musquito.

Culex pipiens.—LINN.

THE common gnat is produced from an aquatic larva of a very singular appearance, and which, when first hatched from the egg*, measures scarcely more than the tenth of an inch in length. In the space however of fourteen days, it arrives at the length of something more than half an inch. In this state the head is very large, and furnished on each side with a pair of jointed processes resembling antennæ; the thorax large and angular; the body suddenly lessening from this part, and continuing of nearly equal diameter to the tail, which is of an abruptly truncated figure, and tipped with four foliaceous processes: before the setting on of the tail is a long, tubular, projecting process, nearly at a right angle from the abdomen, and terminating in a tubular opening, verged by four ovate scales, two of which exceed the rest in size: the whole animal is of a brownish colour, semitransparent, and beset on each side the head, body, and tail, with large tufts of hair: its motions are very lively, and are conducted with a kind of convulsive rapidity, in different directions, and to a small distance at a time. It feeds on the minute vegetables, and animal particles, which it finds in plenty in the stagnant waters in which it resides; and, when arrived at its full growth, casts its skin, and commences chrysalis, the aspect of which is hardly less singular than that of the larva, the head and thorax appearing connate, and exhibiting a large oval mass at the upper part of the animal, while the whole body bends downwards beneath: the thorax is furnished on each side with an upright short tube or spiracle, and it is from these parts that the animal frequently hangs suspended from the surface of the water: the tail is tipped with a pair of leaf-shaped processes. This chrysalites, like the larva from which it proceeded,

* The eggs of the gnat are deposited in close-set groupes of three or four hundred together, and are very small, of a brown colour, and of a cylindric shape, with pointed tips: the whole groupe is placed on the surface of the water, close to the leaf or stalk of some water-plant.

is loco-motive, springing about the water nearly in a similar manner. When ready to give birth to the included gnat, which usually happens in the space of three or four days, it rises to the surface, and the animal quickly emerges from its confinement.

The gnat is supposed to feed both on animal and vegetable juices, but perhaps chiefly on the latter; since, as Reaumur observes, of the millions on millions which swarm in the marshy regions where they are evolved, it can rarely fall to the lot of one in a hundred to taste blood once in its life.

The inconveniences, and even torments, experienced from these insects, in some parts of the world, are hardly to be conceived by those who inhabit the more favoured regions of the European continent. Instances have often been known to occur, of persons whose faces or limbs have been thrown into such a severe inflammation, as even to threaten the most serious consequences.

A warm rainy season is most favourable to the evolution of gnats; and, in such summers, particular districts in most countries are occasionally pestered by their legions. In the Philosophical Transactions, for the year 1767, we have an instance of this kind in the neighbourhood of Oxford, communicated by the late learned Mr. Swinton, of that University.

Oxford, November 15, 1766.

"The gnats have been more numerous, as well as more noxious, here, during the months of July, August, and September, 1766, than perhaps they were ever known before in the memory of man. So many myriads of them have sometimes occupied the same part of the atmosphere, in contiguous bodies, that they have resembled a very black cloud, greatly darkened the air, and almost totally intercepted the solar rays. The repeated bites likewise of these malignant insects have been so severe, that the legs, arms, heads, and other parts affected by them, in many persons, have been swelled to an enormous size. The colour also of these parts, at the same time, was red and fiery, perfectly similar to that of some of the most alarming inflammations."

Mr. Swinton adds, that the swarms of these animals were observed to ascend in columns of at least fifty or sixty feet in height.

But of all the European nations, that of Lapland seems to be

the greatest sufferer from these vexatious animals; which, during the heats of the short summer, fill the air with such swarming myriads, that the poor inhabitants can hardly venture to walk out of their cabins, without having first smeared their hands and faces with a composition of tar and cream, which is found by experience to prevent their attacks. Yet even this seemingly unfavourable circumstance may be considered, in another point of view, as constituting one of the advantages of the country, being, in the expressive words of Linnæus, "*Lapponum calamitas felicissima;*" since the legions of larves which fill the lakes of Lapland form a delicious and tempting repast to innumerable multitudes of aquatic birds; and thus contribute to the support of the very nation which they so strangely infest.

It may be added, that the formidable insect called the musquito, so much dreaded by the inhabitants of the West-Indies, and America, where its bite seems to operate with peculiar malignity, is supposed to be no other than a variety of the common European gnat, which derives additional vigour from the warmer and moister atmosphere of the regions of the western hemisphere.

The true structure of the proboscis or piercer of the gnat, which, in its immediate operation, produces no very acute pain, but which is so often succeeded by such troublesome consequences, is not very easily determined. It seems however to consist of an external scaly sheath or tube, longitudinally divided by a continued slit, and so flexible as to be conveniently doubled or bent, in a greater or less degree, while the secondary or included tube is in the act of absorption. This secondary or included tube appears to consist of fine parallel linear parts, forming, by their junction or juxtaposition, a firm, yet exquisitely fine, sucker, which is forced into the skin of the animal attacked by the insect. The swelling which takes place after the bite, must be supposed to be owing to some acrimonious fluid injected into the punctured part, and which may cause the blood to flow with greater facility into the proboscis, during the time that organ is employed.

[*Swinton. Phil. Trans. Shaw.*

SECTION XII.

Ichneumon.

Ichneumon.—LINN.

THE animals of this genus provide for the support of their offspring in a manner highly extraordinary; depositing their eggs in the bodies of other insects, and generally in those of caterpillars. For this purpose the female ichneumon, selecting her victim, and fastening upon it, pierces its skin with her abdominal tube, and introduces her eggs beneath the surface. In vain the tormented animal endeavours to evade this cruel operation: the ichneumon maintains her hold, nor ceases till she has discharged her whole stock. These eggs in a few days hatch, and the young larves, which resemble minute white maggots, nourish themselves with the juices of the unfortunate animal, which however continues to move about and feed till near the time of its change to chrysalis; when the young brood of Ichneumon-larvæ creep out, by perforating the skin in various places, and each spinning itself up in a small oval silken case, changes into chrysalis; the whole number forming a groupe on the shrivelled body of the caterpillar which had afforded them nourishment; and, after a certain period, emerge in the state of complete Ichneumons. One of the most familiar examples of this process, is afforded by the well-known caterpillar of the common white or cabbage butterfly; which, in the autumnal season, may be frequently observed to creep up some wall, or other convenient surface, in order to undergo its own change into chrysalis; but, in the space of a day or two, a numerous tribe of small maggots will be seen to emerge from it, and immediately proceed to envelop themselves in distinct yellow silken cases; the whole forming a groupe around the caterpillar. The ichneumons proceeding from these are the species called by Linnæus ichneumon glomeratus: their colour is black, with yellow legs: they usually make their appearance in about three weeks from the time of their spinning themselves up. Other small species of Ichneumon pierce the skins of newly changed chrysalites of butterflies and moths, in which their larves remain during their own incomplete state; as the ichneumon puparum of Linnæus, a very small species, of a gilded

Engraved by Owen, from a Drawing by Craig

For the Gallery of Nature

BEES, LANTHORN FLY, &c.

green colour. Others again are so very small that the female pierces even the eggs of moths and butterflies, and deposits her own in each; as the ichneumon ovulorum of Linnæus, one of the smallest of the whole tribe: it is of a black colour, with rufus legs, and long filiform antennæ.

Other Ichneumons are of a very considerable size, and the females of these select some larger caterpillar for their victim; as those of the larger sphinges, such as the S. Ligustri, convolvuli, &c. or one of the large and middle-sized moths, as the phalæna vinula, quercus, &c. &c. These large ichneumons are generally bred in small numbers, and sometimes the female deposits but a single egg in the selected caterpillar. This may be instanced in the ichneumon ramidulus, the larve of which is thus bred in the caterpillar of the sphinx ligustri: it is a very large ichneumon, of a dull yellowish colour, with a cast of brown on the thorax, and with the antennæ and abdomen tipped with black: the abdomen is also of a falciform shape, curving downwards, and compressed on the sides. Ichneumon luteus is a large species, nearly allied to the former, and of similar manners.

The seeming severity of the process ordained by nature, for giving birth to the genus ichneumon, may be much diminished by supposing, (what all the ensuing phænomena seem to imply) that, after the first operation of piercing the skin, and depositing the eggs, is performed by the female ichneumon, the caterpillar feels no acute pain; the included enemies feeding only on its juices, and evidently sparing the more important organs; so that it loses its life by a very gradual decay.

[*Swammerdam. Shaw. Roësel.*

SECTION XIII.

Bee.

Apis mellifica.—Linn.

This is an insect, that from its curious instinctive faculties, exquisite mechanical art, and above all useful productive labour, is entitled to minute attention; and whose history affords an equal portion of amusement and instruction. Perhaps the two most

elaborate accounts that have reached us upon its economy, are Mr. John Hunter's, given in the Philosophical Transactions for 1792, and M. Huber's, contained in his *Nouvelles Observations sur les Abeilles*, addressed to M. Bonnet, the celebrated author of the "Contemplations de la Nature." The description we are now about to offer shall be drawn up from both these.

"There are three periods, observes Hunter*, at which the history of the bee may commence: first in the spring, when the queen begins to lay her eggs; in the summer, at the commencement of a new colony; or in the autumn, when they are going into winter-quarters. I shall begin the particular history of the bee with the new colony, when nothing is formed; for it begins then every thing that can possibly happen afterwards.

"When a hive sends off a colony, it is commonly in the month of June, but that will vary according to the season; for in a mild spring bees sometimes swarm in the middle of May, and very often at the latter end of it. Before they come off, they commonly hang about the mouth of the hole, or door of the hive, for some days, as if they had not sufficient room within for such hot weather, which I believe is very much the case; for if cold or wet weather come on, they stow themselves very well, and wait for fine weather. But swarming appears to be rather an operation arising from necessity, for they would seem not naturally to swarm, because if they have an empty space to fill, they do not swarm; therefore by increasing the size of the hive, the swarming is prevented. This period is much longer in some than in others. For some evenings before they come off, is often heard a singular noise, a kind of ring, or sound of small trumpet; by comparing it with the notes of the piano-forte, it seems to be the same sound with the lower A of the treble.

"The swarm commonly consists of three classes; a female, or females†; males, and those commonly called mules, which are supposed to be of no sex, and are the labourers; the whole about two quarts in bulk, making about six or seven thousand. It is a

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* We quote him with Dr. Shaw's occasional abridgements and variations. EDITOR.

† "I have reason to believe that never more than one female comes off with a swarm."

question that cannot easily be determined, whether this old stock sends off entirely young of the same season, and whether the whole of their young ones, or only part. As the males are entirely bred in the same season, part go off; but part must stay, and most probably it is so with the others. They commonly come off in the heat of the day, often immediately after a shower; who takes the lead I do not know, but should suppose it was the queen. When one goes off, they all immediately follow, and fly about seemingly in great confusion, although there is one principle actuating the whole. They soon appear to be directed to some fixed place; such as the branch of a tree or bush, the cavities of old trees, holes of houses leading into some hollow places; and whenever the stand is made, they all immediately repair to it, till they are all collected. But it would seem, in some cases, that they had not fixed upon any resting place before they came off; or if they had, that they were either disturbed, if it was near, or that it was at a great distance; for, after hovering some time, as if undetermined, they fly away, mount up into the air, and go off with great velocity. When they have fixed upon their future habitation, they immediately begin to make their combs, for they have the materials within themselves. I have reason to believe that they fill their crops with honey when they come away; probably from the stock in the hive. I killed several of these that came away, and found their crops full, while those that remained in the hive had their crops not near so full: some of them came away with farina on their legs, which I conceive to be rather accidental. I may just observe here, that a hive commonly sends off two, sometimes three swarms in a summer; but that the second is commonly less than the first, and the third less than the second; and this last has seldom time to provide for the winter: they shall often threaten to swarm, but do not; whether the threatening is owing to too many bees, and their not swarming is owing to there being no queen, I do not know. It sometimes happens that the swarm shall go back again; but in such instances I have reason to think that they have lost their queen, for the hives to which the swarm have come back do not swarm the next warm day, but shall hang out for a fortnight, or more, and then swarm; and when they do, the swarm is commonly much larger than before, which makes me suspect that the waited for the queen that was to go off with the next swarm.

"So far we have set the colony in motion. The materials of their dwelling, or comb, which is the wax, is the next consideration, with the mode of forming, preparing, or disposing of it. In giving a totally new account of the wax, I shall first shew it can hardly be what it has been supposed to be. First, I shall observe that the materials, as they are found composing the comb, are not to be found in the same state (as a composition) in any vegetable, where they have been supposed to be got. The substance brought in on their legs, which is the farina of the flowers of plants, is, in common, I believe, imagined to be the materials of which the wax is made, for it is called by most the wax: but it is the farina, for it is always of the same colour as the farina of the flower where they are gathering; and indeed we see them gathering it, and we also see them covered almost all over with it, like a dust; nevertheless, it has been supposed to be the wax, or that the wax was extracted from it. Reaumur is of this opinion. I made several experiments, to see if there was such a quantity of oil in it, as would account for the quantity of wax to be formed, and to learn if it was composed of oil. I held it near the candle; it burnt, but did not smell like wax; and had the same smell, when burning, as farina when it was burnt. I observed that this substance was of different colours on different bees, but always of the same colour on both legs of the same bee; whereas new made comb was all of one colour. I observed, that it was gathered with more avidity for old hives, where the comb is complete, than for those hives where it is only begun, which we could hardly conceive if it was the materials of wax: also we may observe, that at the very beginning of a hive, the bees seldom bring in any substance on their legs for two or three days, and after that the farina gatherers begin to increase; for now some cells are formed to hold it as a store, and some eggs are laid, which when hatched will require this substance as *food*, and which will be ready when the weather is wet. I have also observed, that when the weather has either been so cold, or so wet, in June, as to hinder a young swarm from going abroad, they have yet in that time formed as much new comb, as they did in the same time when the weather was such as allowed them to go abroad. I have seen them bring it in about the latter end of March, and have observed, in glass hives, the bees with the farina on their legs, and have seen them disposing of it, as will be described hereafter.

"The wax is formed by the bees themselves; it may be called an external secretion of oil, and I have found that it is formed between each scale of the under side of the belly. When I first observed this substance, in my examination of the working bee, I was at a loss to say what it was: I asked myself if it was new scales forming; and whether they cast the old, as the lobster, &c. does? but it was to be found only between the scales, on the lower side of the belly. On examining the bees through glass hives, while they were climbing up the glass, I could see that most of them had this substance; for it looked as if the lower, or posterior edge of the scale, was double, or that there was a double scale: but I perceived it was loose, not attached. Finding that the substance brought in on their legs was farina, intended, as appeared from every circumstance, to be the food of the maggot, and not to make wax; and not having yet perceived any thing that could give them the least idea of wax, I conceived these scales might be it; at least I thought it necessary to investigate them. I therefore took several on the point of a needle, and held them to a candle, where they melted, and immediately formed themselves into a round globe; upon which I no longer doubted but this was the wax, which opinion was confirmed to me by not finding those scales but in the building season. In the bottom of the hive we see a good many of the scales lying loose, some pretty perfect, others in pieces. I have endeavoured to catch them, either taking this matter out of themselves, from between the scales of the abdomen, or from one another, but never could satisfy myself in this respect: however, I once caught a bee examining between the scales of the belly of another, but I could not find that it took any thing from between. We very often see some of the bees wagging their belly, as if tickled, running round, and to and fro, for only a little way, followed by one or two other bees, as if examining them. I conceived they were probably shaking out the scales of wax, and that the others were ready upon the watch to catch them, but I could not absolutely determine what they did. It is with these scales that they form the cells called comb, but perhaps not entirely, for, I believe, they mix farina with it; however, this only occasionally, when probably the secretion is not in great plenty. I have some reason to think, that where no other substance is introduced, the

thickness of the scale is the same with that of the sides of the comb; if so, then a comb may be no more than a number of these united; but a great deal of the comb seems to be too thick for this, and, indeed, would appear to be a mixture, similar to the covering of the chrysalis. The wax naturally is white, but when melted from the comb at large, it is yellow. I apprehend this might arise from its being stained with honey, the excrement of the maggots, and with the bee-bread. I steeped some white comb in honey, boiled some with farina, as also with old comb, but I cannot say that it was made yellower. Wax, by bleaching, is brought back to its natural colour, which is also a proof that its colour is derived from some mixture. I have reason to believe that they take the old comb, when either broken down, or by any accident rendered useless, and employ it again; but this can only be with combs that have had no bees hatched in them, for the wax cannot be separated from the cells afterwards. Reaumur supposed that they new-worked up the old materials, because he found the covering of the chrysalis of a yellower colour than the other parts of the new comb; but this is always so, whether they have old yellow comb to work up, or not, as will be shewn.

"The bees who gather the farina also form the wax, for I found it between their scales.

"The cells, or rather the congeries of cells, which compose the comb, may be said to form perpendicular plates, or partitions, which extend from top to bottom of the cavity in which they build them, and from side to side. They always begin at the top, or roof of the vault, in which they build, and work downwards; but if the upper part of this vault, to which their combs are fixed, is removed, and a dome is put over, they begin at the upper edge of the old comb, and work up into the new cavity at the top. They generally may be guided as to the direction of their new plates of comb, by forming ridges at top, to which they begin to attach their comb. In a long hive, if these ridges are longitudinal, their plates of comb will be longitudinal; if placed transverse, so will be the plates; and if oblique, the plates of comb will be oblique. Each plate consists of a double set of cells, whose bottoms form the partition between each set. The plates themselves are not very regularly arranged, nor forming a regular plane where they might

have done so; but are often adapted to the situation, or shape of the cavity in which they are built. The bees do not endeavour to shape their cavity to their work, as the wasps do, nor are the cells of equal depths, also fitting them to their situation; but as the breeding cells must all be of a given depth, they reserve a sufficient number for breeding in, and they put the honey into the others, as also into the shallow ones. The attachment of the comb round the cavity is not continued, but interrupted, so as to form passages; there are also passages in the middle of the plates, especially if there be a cross stick to support the comb; these allow of bees to go across from plate to plate. The substance which they use for attaching their combs to surrounding parts is not the same as the common wax; it is softer and tougher, a good deal like the substance with which they cover in their chrysalis, or the humble bee surrounds her eggs. It is probably a mixture of wax with farina. The cells are placed nearly horizontally, but not exactly so; the mouth raises a little, which probably may be to retain the honey the better; however this rule is not strictly observed, for often they are horizontal, and towards the lower edge of a plane of comb they are often declining. The first combs that a hive forms are the smallest, and much neater than the last, or lowermost. Their sides, or partitions between cell and cell, are much thinner, and the hexagon is much more perfect. The wax is purer, being probably little else but wax, and it is more brittle. The lower combs are considerably larger, and contain much more wax, or perhaps, more properly, more materials; and the cells are at such distances as to allow them to be of a round figure: the wax is softer, and there is something mixed with it. I have observed that the cells are not all of equal size, some being a degree larger than the others; and that the small are the first formed, and of course at the upper part, where the bees begin; and the larger are nearer the lower parts of the comb, or last made: however, in hives of particular construction, where the bees may begin to work at one end, and can work both down, and towards the other end, we often find the larger cells both on the lower part of the combs, and also at the opposite end. These are formed for the males to be bred in; and in the hornet's and wasp's combs, there are larger cells for the queens to be bred in: these are also formed in the lower tier, and the last formed.

"The first comb made in a hive is all of one colour, viz. almost white; but is not so white towards the end of the season, having then more of a yellow cast."

Thus far we have followed Mr. Hunter's very ingenious and elaborate investigation. The history proceeds to explain the production and nature of the queen-bee, the duties of the mules and of the labourers, and the process of swarming. But as various errors appear to have found their way into this latter part of the investigation, we shall now proceed to copy from M. Huber's work, which we shall give in the abridged language of the editors of the Pantologia*.

A hive contains three kinds of bees. 1. A single queen-bee, distinguishable by the great length of her body, and the proportional shortness of her wings. 2. Working-bees, female non-breeders, or, as they were formerly called, neuters, to the amount of many thousand: these are the smallest sized bees in the hive, and are armed with a sting. 3. Drones or males, to the number perhaps of 1500 or 2000: these are larger than the workers, and of a dark colour; they make a great noise in flying, and have no sting. The whole labour of the community is performed by the workers: they elaborate the wax, and construct the cells; they collect the honey, and feed the brood. The drones, numerous as they are, serve no other purpose than to insure the impregnation of the few young queens that may be produced in the course of the season; and they are regularly massacred by the workers in the beginning of autumn.

It is the office of the queen-bee to lay the eggs. These remain about three days in the cells before they are hatched. A small white worm then makes its appearance, (called indifferently worm, larva, maggot or grub): this larva is fed with honey for some days, and then changes into a nymph or pupa. After passing a certain period in this state, it comes forth a perfect winged insect.

M. Hubert employed in his experiments an improved glass hive of his own invention. He styles it the leaf-hive or book-hive (*ruche en feuilles*, or *ruche en livre*), from its opening and shutting somewhat in the manner of the leaves, of a book. It consists of several frames or boxes a foot square, and in width fifteen French

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* Art. Bee.

lines, or sixteen English, that is, an inch and one-third: the boxes are placed parallel to each other, and connected together by hinges. Availing himself of a known instinct in the bees, which leads them to complete any piece of a comb in the direction in which they find it begun, unless they meet with some insurmountable obstacles; he placed pieces of comb in each box, in such a position as to induce them to build perpendicular to the horizon. The lateral surface of the combs were thus only three or four lines distant from the glass panes; and by opening the different divisions of the hive successively, both surfaces of every comb were, at pleasure, brought fully into view. M. Huber did not experience any difficulty in introducing swarms into these leaf-hives: and he found, that after the lapse of about three days, when the colony was fairly established, the bees submitted patiently to his daily inspections. Their tranquility he ascribes, with some probability, to the surprise, and perhaps fear, produced by the sudden admission of the light; for he observed that they were always less tractable after sunset. Both the queen-bee and the drones being considerably larger than the working bees, by adapting glass tubes exactly to the size of the workers, both queens and drones may be effectually excluded or effectually kept prisoners, as the nature of the experiments may require.

M. Huber commences his inquiry with examining into the nature of the impregnation of the queen bee, a subject hitherto involved in the most profound obscurity. The drones are evidently males; but the most careful observation had never been able to detect any thing like sexual intercourse between them and the queen bee. Schirach (a German naturalist, well known for his discoveries concerning bees) boldly denied that such intercourse was necessary to her impregnation; and in this he is stoutly supported by our north-countryman Bonner. Swammerdam, again, remarking that the drones, at certain seasons, when collected in clusters, exhaled a strong odour, broached an opinion that this odour, proceeding from whole clusters of drones, was a kind of *aurora seminalis*, which produced fecundation by penetrating the body of the female. There are generally from 1500 to 2000 males in a hive, while there are only two or three queens to be impregnated in a season; and Swammerdam seems to have found, in his hypothesis, an easy explanation of this enormous disproportion in

the numbers of the sexes. Reaumur, however, combated this fanciful doctrine; and M. Huber has confuted it by direct experiment. He confined all the drones of a hive in a tin case, perforated with minute holes, sufficient to allow any emanation to escape. This tin case was placed in a well inhabited hive, where there was a young queen, who could not fail to be subjected to the odour; but she remained barren.

Maraldi was the first to suggest another hypothesis, which apparently possessed a greater degree of probability; he imagined that the eggs were fecundated by the drones, after being deposited in the cells, in a way analogous to the fecundation of the spawn of fishes by the milters. Mr. Debraw of Cambridge, (in the Phil. Trans. 1777), strenuously supported this doctrine, and gave it a certain degree of plausibility, by referring to numerous experiments: he even affirmed, that the milk-like fluid of the drones might be seen in the cells. The supposition that the drones performed this important office, satisfactorily accounted for the prodigious numbers of them found in a hive. But Mr. Debraw does not seem to have attended to this circumstance,—that great numbers of eggs are laid by the queen between the months of September and April, which prove fertile, although in that season there exist no males to supply the milk-like liquor. M. Huber is of opinion, that the appearance of a fluid was merely an optical illusion, arising from the reflection of the light at the bottom of the cell. He made the direct experiment of rigidly excluding every male from a hive, and yet found that eggs laid by the queen in this interval were as fertile as when the males were admitted. Mr. Debraw's opinion, therefore, must be erroneous; for the fertility of these eggs must have depended on the previous impregnation of the queen herself, and not on any thing that could happen after they were deposited.

M. Hattorf, in a memoir published in Schirach's work, endeavoured to shew that the queen is impregnated by herself. This was also M. Schirach's opinion; and it seems to be that of Mr. Bonner. It is an opinion, however, that requires no refutation. The cautious Huber, remarking how much confusion had arisen from making experiments with queens taken indiscriminately from the hives (the source of the error just mentioned), thenceforward selected those which were decidedly in a virgin state, and with

whose history he was acquainted from the moment they had left the cell.

The illustrious Linnæus was of opinion that the queen bees formed an actual union with the drones; and he seems even to have suspected that this union proved fatal to the latter. His opinion on both points has now been verified. For, from many experiments made in the course of the year 1787 and 1788, M. Huber found, that the queens are never impregnated as long as they remain in the interior of the hive: if confined within its walls, they continue barren, though amidst the seraglio of males. To receive the approaches of the male, the queen soars high in the air, choosing that time of day when the heat has induced the drones to issue from the hive; and love is now ascertained to be the motive of the only distant journey which a young queen ever makes. From this excursion she returns in the space of about half an hour, with the most evident marks of fecundation; for, far from being satisfied with the prolific rura of Swammerdam, she actually carries away with her the ipsa verenda of the poor drone, who never lives to see its own offspring, but falls a sacrifice to the momentary bliss of his aërial amour. The most complete proof of these facts is afforded by the detail of a number of concurring experiments. It is curious that our north-countryman, Bonner, should have remarked those aërial excursions of the young queens, without ever suspecting their real object, or observing the marks of fecundation upon their return to the hive. The worthy bee-master, as he styles himself in his book, thought they were merely taking an airing. "I have often," says he, "seen young queens take an airing on the second or third day of their age." M. Huber also assigns a cause for the existence of such a great number of males. "As the queen is obliged to traverse the expanse of the atmosphere, he observes, it is requisite the males should be numerous, that she may have the chance of meeting some one of them." But the reason why impregnation cannot be accomplished within the hive has not yet been ascertained; nor is the cause here assigned for the great number of males quite satisfactory.

M. Huber next states the accidental discovery of the very singular and unexpected consequences which follow from retarding the impregnation of the queen-bee beyond the twentieth or

twenty-first day of her life. In the natural order of things, or when impregnation is not retarded, the queen begins to lay the eggs of workers forty-six hours after her intercourse with the male, and she continues for the subsequent eleven months to lay none but these; "and it is only after this period, that a considerable and uninterrupted laying of the eggs of drones commences. When, on the contrary, impregnation is retarded after the twenty-eight day, the queen begins, from the forty sixth hour, to lay the eggs of drones; and she lays no other kind during her whole life." It would be tedious to detail the experiments; they were numerous, and the results uniform. "I occupied myself," says M. Huber, "the remainder of 1787, and the two subsequent years, with experiments on retarded fecundation, and had constantly the same results. It is undoubted, therefore, that when the copulation of queens is retarded beyond the twentieth day, only an imperfect impregnation is operated; instead of laying the eggs of workers and of males equally, she will lay those of males only."

This discovery is entirely M. Huber's own: and so difficult is it to offer any plausible explanation of the fact, that he himself has scarcely attempted it. The difficulty is much increased when we consider that a single interview with the male is sufficient for fecundifying the whole eggs that a queen will lay in the course of at least two years: we cannot avoid observing, however, that a similar fact occurs in the economy of the female aphis, which by a single impregnation is well known to produce several successive generations. In the present instance, it would be in vain to say that an early impregnation may be necessary for the eggs of workers, and a later for those of drones. It will be recollected, that, in the natural state, the queen lays the eggs of workers for the first eleven months, to the amount of many thousands, before she lays a single drone egg; but that when her impregnation has been for a few days retarded, she begins at once to lay the eggs of drones. The generally admitted principle of the successive expansion of eggs render this very puzzling; for how comes it that eggs of drones, which naturally require eleven months to come to perfection in the ovaria of the queen, are, in this case, perfected in forty-eight hours? What has become of the vast multitude of workers' eggs that the queen ought first to have deposited? It is certain that, during the

first twenty days of her life, the eggs of workers ought to be laid; but it would seem that, intercourse with the male being denied, the first set of eggs become effete; they waste away, and perhaps drop from the animal. A fact mentioned by M. Huber, in a subsequent page, seems to support this notion. "The body of those queens whose impregnation has been retarded, is shorter than common: the extremity remains slender, while the first two rings next the thorax are uncommonly swoln." On dissecting the double ovary, both branches were found to be equally expanded and equally sound; but the eggs were apparently not placed so closely together as in common queens. A queen in ordinary circumstances, lays about 3000 eggs in the space of two months, which is at the rate of 50 a day. It was not correctly ascertained, whether the queens whose impregnation was retarded, laid a number of drone eggs corresponding to the whole number of eggs, both of workers and drones which they ought to have deposited: but it is certain, that they laid a greater number of drone eggs than they ought naturally to have done. The hives in which only drones are produced always failed; and, indeed, generally broke up before the queens had done laying; for, after the lapse of some time, the workers finding themselves overwhelmed with drones, *fruges consumere nati*, and receiving no increase of their own number, abandoned the hive, and at the same time dispatched their unfortunate sovereign.—In order to throw some light on this curious subject, M. Huber suggests the propriety of instituting analogous experiments on other insects; by retarding, for example, the impregnation of the females of other species of bees, of wasps, and of butterflies.

In the course of additional experiments, some other curious points in the natural history of the bee were accidentally illustrated. Thus, a queen, twenty-seven days old, having been impregnated on the 31st of October, did not begin to lay at the expiration of forty-six hours, apparently on account of the weather having, in the mean time, become extremely cold. She was confined in a hive all the winter; and on the 4th of April ensuing, prodigious numbers both of larves and pupes were found; and all of them produced drones.

"Here, as in the other experiments, retardation had rendered the queen incapable of laying the eggs of workers: but this result is

the more remarkable, as she did not commence laying until four months and a half after fecundation. It is not rigourously true, therefore, that the term of forty-six hours elapses between the copulation of the female and her laying; the interval may be much longer, if the weather grows cold. Lastly, it follows, that although cold will retard the laying of a queen impregnated in autumn, she will begin to lay in spring without requiring new copulation."

M. Huber had also an opportunity of correcting those naturalists, who maintain that the working bees are charged with the task of conveying into proper cells such eggs as may be misplaced by the queen. He put a queen, who was ready to lay worker's eggs, into a prepared hive which contained only the cells of drones, but which communicated, by a narrow tube (sufficient to permit workers to pass, but too small for the queen), with another hive which contained plenty of the cells of workers. The queen, taught by nature the kind of eggs she was about to lay, searched about for suitable cells; but finding none, she chose rather to drop her eggs at random, than place those of workers in the cells of drones. The eggs thus dropped, soon disappeared; and careless observers might have concluded that they were carried off by the workers to the proper cells; but none were to be seen there; and the author soon ascertained that they were really eaten up by the workers. Thus it was proved that the care of depositing properly the respective kinds of eggs is left entirely to the instinct of the queen; and that the workers running off with misplaced eggs in order to devour them, has been mistaken for their tenderly conveying them to the right cells. When the impregnation of the queen-bee is retarded, her instinct seems to suffer; for she then lays her eggs indiscriminately in large and in small cells; those laid in large cells producing large drones; those in small cells, small drones; and she has been known to lay the eggs of drones even in royal cells, some of which kind of cells the bees always take care to construct whenever the queen begins to lay male eggs. It is remarkable that the workers were, on these last occasions, deceived, and treated the embryo drones as if they had been truly of the royal brood.

The working-bees had been for ages considered as entirely destitute of sex; and hence, in the writings of many authors they are denominated neuters. From the experiments of Schirach and

of Huber, it seems now to be clearly ascertained that the workers are really of the female sex; but that the organs of generation are small and imperfect, being capable, however, of development, if the larvas be fed with royal jelly.

M. Huber confirms the curious discovery of M. Schirach that when bees are by any accident deprived of their queen, they have the power of selecting one or two grubs of workers, and of converting them into queens; and that they accomplish this by greatly enlarging the cells of those selected larvas, by supplying them more copiously with food, and with food of a more pungent sort than is given to the common larvas. "All my researches," says M. Huber, "establish the reality of the discovery. During ten years that I have studied bees, I have repeated M. Schirach's experiment so often, and with such uniform success, that I can no longer have the least doubt on the subject." The same testimony is given by Mr. Bonner, who declares, that "having repeated the experiment again and again, he can affirm it with the utmost confidence and certainty." M. Schirach's discovery may now therefore be considered as established beyond controversy; and Mr. Key's doubts, and the late Mr. John Hunter's strictures, in the Philosophical Transactions for 1792, must consequently fall to the ground.

M. Huber gives the following curious account of the manner in which bees proceed in forming capacious cells for the workers' grubs destined to royalty. "Bees soon become sensible of having lost their queen, and in a few hours commence the labour necessary to repair their loss. First, they select the young common worms, which the requisite treatment is to convert into queens, and immediately begin with enlarging the cells where they are deposited. Their mode of proceeding is curious; and the better to illustrate it, I shall describe the labour bestowed on a single cell, which will apply to all the rest containing worms destined for queens. Having chosen a worm, they sacrifice three of the contiguous cells; next they supply it with food, and raise a cylindrical enclosure around, by which the cell becomes a perfect tube, with a rhomboidal bottom; for the parts forming the bottom are left untouched. If the bees damaged it, they would lay open three corresponding cells on the opposite surface of the comb, and

consequently destroy their worms, which would be an unnecessary sacrifice, and nature has opposed it. Therefore, leaving the bottom rhomboidal, they are satisfied with raising a cylindrical tube around the worm, which, like the other cells in the comb, is horizontal. But this habitation remains suitable to the worm called to the royal state, only during the first three days of its existence; another situation is requisite for the other two days it is a worm. During that time, though so small a portion of its life, it must inhabit a cell nearly of a pyramidical figure, and hanging perpendicularly. The workers therefore gnaw away the cells surrounding the cylindrical tube, mercilessly sacrifice their worms, and use the wax in constructing a new pyramidical tube, which they solder at right angles to the first, and work it downwards. The diameter of this pyramid decreases insensibly from the base, which is very wide, to the point. In proportion as the worm grows, the bees labour in extending the cell, and bring food, which they place before its mouth, and around its body, forming a kind of cord around it. The worm, which can move only in a spiral direction, turns incessantly to take the food before its head: it insensibly descends, and at length arrives at the orifice of the cell. Now is the time of transformation to a nymph. As any further care is unnecessary, the bees close the cell with a peculiar substance appropriated for it, and there the worm undergoes both its metamorphoses."

M. Huber states several points, however, in which his experience leads him to differ from M. Schirach. The latter observer having remarked, that larves three days old were generally selected for the royal treatment, concluded that this age of three days was an essential requisite; but M. Huber found, that those two days old, or only a few hours old, were sometimes chosen to the throne, and became perfect queens. We shall extract one experiment at length, as it both demonstrates the reality of common larves being converted into queens, and shows the little influence which their age has on the effects of the operation. "I put some pieces of comb, with some workers' eggs, in the cells, and of the same kind as those already hatched, into a hive deprived of the queen. The same day several cells were enlarged by the bees, and converted into royal cells, and the worms supplied with a thick bed of jelly.

Five were then removed from those cells, and five common worms, which, forty-eight hours before, we had seen come from the egg, substituted for them. The bees did not seem aware of the change; they watched over the new worms the same as over those chosen by themselves; they continued enlarging the cells, and closed them at the usual time. When they had brooded on them (for such seems to be M. Huber's opinion) for seven days, we removed the cells, to see the queens that were to be produced. Two were excluded, almost at the same moment, of the largest size, and well formed in every respect. The term of the other cells having elapsed, and no queen appearing, we opened them. In one was a dead queen, but still a nymph: the other two were empty. The worms had spun their silk coccoons, but died before passing into their nymphine state, and presented only a dry skin. I can conceive nothing more conclusive than this experiment. It demonstrates that bees have the power of converting worms of workers into queens, since they succeeded in procuring queens by operating on the worms which we ourselves had selected. It is equally demonstrated, that the success of the operation does not depend on the worms being three days old, as those entrusted to the bees were only two."

He mentions another experiment, by which it appears, that larves, only a few hours old (as already hinted) are sometimes destined to replace a lost queen.

M. Huber next relates some experiments which confirm the singular discovery of M. Riems, concerning the existence, occasionally, of common working bees that are capable of laying eggs,—which, we may remark, is certainly a most convincing proof of their being of the female sex. Eggs were observed to increase in number daily, in a hive in which there were no queens of the usual appearance; but small queens considerably resemble workers, and to discriminate them required minute inspection. "My assistant," says M. Huber, "then offered to perform an operation that required both courage and patience, and which I could not resolve to suggest, though the same expedient had occurred to myself. He proposed to examine each bee in the hive separately, to discover whether some small queen had not insinuated herself among them, and escaped our first researches.—It was necessary, therefore, to seize every one of the bees, notwithstanding their

irritation, and to examine their specific character with the utmost care. This my assistant undertook, and executed with great address. Eleven days were employed in it; and during all that time, he scarcely allowed himself any relaxation, but what the relief of his eyes required. He took every bee in his hand; he attentively examined the trunk, the hind limbs, and the sting; and he found that there was not one without the characteristics of the common bee, that is, the little basket on the hind legs, the long trunk, and the straight sting."

They afterwards seized a fertile worker in the very act of laying; and they thus describe her appearance. She presented all the external characteristics of common bees; the only difference we could recognize, and that was a very slight one, consisting in the belly seeming less, and more slender than that of workers. On dissection, her ovaries were found more fragile, smaller, and composed of fewer oviducts than the ovaries of queens. We counted eleven eggs of sensible size, some of which appeared ripe for laying. This ovary was double, like that of the queens." How or when these fertile workers are impregnated is quite unknown.

Fertile workers resemble queens whose impregnation has been retarded, in this, that they lay the eggs of drones only, never those of workers; and also in this, that they sometimes place their eggs in royal cells. It is remarkable, however, that in case a queen, whose impregnation has been retarded, lays her eggs in royal cells, the bees build them up, and brood over them until the last metamorphosis of the included drones; but that when eggs are deposited in the royal cells by fertile workers, the bees, although at first they pay due attention to the larves, never fail to destroy them in the course of a few days.

Schirach's discoveries certainly proved, that common working bees are radically of the female sex. Huber, we have seen, detected and described their ovaries; and the notion, long entertained, of their being of the neuter gender, must be now justly exploded as a solescism in animated nature. Here, we cannot help observing, that the doctrine of workers being of the female sex has accidentally, and most unintentionally, received a very striking collateral confirmation from one of its most eminent opposers. Linnæus had asserted that there are ten joints in the antennas of queens; eleven in those of drones; and fifteen in those of workers: and his asser-

tion on this point naturally passed current as authentic fact. Taking it for granted, therefore, that there existed such a discrepancy in the structure of the antennas of queens and of workers, naturalists were startled at the new doctrine, that both were females, and that the larves of workers could be converted into queens. Mr. Kirby has corrected the Swedish knight, and informs us, that there are positively the same number of articulations in the antennas of queens as in those of workers. This testimony is not the less deserving of credit, since it militates against Mr. Kirby's own notions, that workers are proper neuters.

M. Huber imagines he has discovered the cause of the partial expansion of the sexual organs in those workers that prove fertile. He observes, that fertile workers appear in those hives only, that have lost the queen, and where of course a quantity of royal jelly is prepared for feeding the larves intended to replace her. He suspects that bees, either by accident, or by a particular instinct, the principle of which is unknown, drop some particles of royal jelly into cells, contiguous to those containing the worms destined for queens. The larves of workers that thus casually receive portions of this active aliment are affected by it, and their ovaries acquire a certain degree of expansion: from the want of full feeding, and owing to the smallness of their cells, this expansion is only partial, and such fertile workers remain of the ordinary size of working-bees, and lay only a few eggs. This idea of a developement of sexual organs by the use of a peculiar food is not new. It constituted a doctrine of the Epicurean theory, and is alluded to by Lucretius in the following, as well as in a variety of other passages *.

Multa, videmus, enim rebus concurrere debent,
Ut propagando possint procudere secla:
Pabula primum ut sint, genitalia deinde per artus
Semina, quæ possint membris manare remissis.

For with cause,
Cause ceaseless must combine, or nought can rise
Of race generic: genial foods must spring,
And genial organs, from the total frame
The vital seeds concoctted to collect. GOOD.

* De Rer. Nat. v. 847.

It is said that the royal jelly, when pure, may be known by its pungent taste, but when mixed with other substances, it is not easily distinguished. M. Huber repeatedly tried to feed some of the larves of workers in other parts of the hive with the royal jelly, in order to observe the consequences; but he found this to be a vain attempt, the bees immediately destroying such worms, and themselves devouring the food. It has not therefore been directly ascertained, that all fertile workers proceed from larves that have received portions of the royal food; but M. Huber observed, that they were uniformly such as had passed the vermicular state, in cells contiguous to the royal ones. "The bees," he remarks, "in their course thither, will pass in numbers over them, stop, and drop some portion of the jelly destined for the royal larves." This reasoning, though not conclusive, is plausible. The result is so uniform, that M. Huber says he can, whenever he pleases, produce fertile workers in his hives. They are probably, he adds, always produced, in greater or less numbers, whenever the bees have to create to themselves a new queen; and the reason that they are so seldom seen, probably is, that the queen bees attack and destroy them without mercy, whenever they perceive them.

When a supernumerary queen is produced in a hive, or is introduced into it in the course of experiment, either she or the rightful owner soon perishes. The German naturalists, Schirach and Riems, imagined that the working bees assailed the stranger, and stung her to death. Reaumur considered it as more probable, that the sceptre was made to depend on the issue of a single combat between the claimants; and this conjecture is verified by the observations of Huber. The same hostility towards rivals, and destructive vengeance against royal cells, animates all queens, whether they be virgins, or in a state of impregnation, or mothers of numerous broods. The working-bees, it may here be remarked, remain quiet spectators of the destruction, by the first-hatched queen, of the remaining royal cells; they approach only to share in the plunder presented by their havock-making mistress, greedily devouring any food found at the bottom of the cells, and even sucking the fluid from the abdomen of the nymphs before they toss out the carcass.

The following fact, connected with this subject, is one of the most curious perhaps in the whole history of this wonderful insect. Whenever the workers perceive that there are two rival queens in the hive, numbers of them crowd around each; they seem to be perfectly aware of the approaching deadly conflict, and willing to prompt their Amazonian chieftains to the battle; for as often as the queens shew a disinclination to fight, or seem inclined to recede from each other, or to fly off, the bees immediately surround and detain them; but when either combatant shows a disposition to approach her antagonist, all the bees forming the clusters instantly give way, to allow her full liberty for the attack. It seems strange that those bees who in general show so much anxiety about the safety of their queen, should, in particular circumstances, oppose her preparations to avoid impending danger,—should seem to promote the battle, and to excite the fury of the combatants.

When a queen is removed from a hive, the bees do not immediately perceive it; they continue their labours, "watch over their young, and perform all their ordinary occupations. But, in a few hours, agitation ensues; all appears a scene of tumult in the hive. A singular humming is heard: the bees desert their young; and rush over the surface of the combs with a delirious impetuosity." They have now evidently discovered that their sovereign is gone; and the rapidity with which the bad news spreads through the hive, to the opposite side of the combs, is very remarkable. On replacing the queen in the hive, tranquillity is almost instantly restored. The bees, it is worthy of notice, recognise the individual person of their own queen. If another be palmed upon them, they seize and surround her, so that she is either suffocated or perishes by hunger; for it is very remarkable, that the workers are never known to attack a queen bee with their stings. If, however, more than eighteen hours have elapsed before the stranger queen be introduced, she has some chance to escape: the bees at first seize and confine her; but less rigidly; and they soon begin to disperse, and at length leave her to reign over a hive in which she was at first treated as a prisoner. If twenty-four hours have elapsed, the stranger will be well received from the first, and at once admitted to the sovereignty of the hive.

In short, it appears that the bees when deprived of their queen, are thrown into great agitation; that they wait about twenty hours, apparently in hopes of her return; but that after this interregnum, the agitation ceases; and they set about supplying their loss by beginning to construct royal cells. It is when they are in this temper, and not sooner, that a stranger queen will be graciously received: and upon her being presented to them, the royal cells, in whatever state of forwardness they may happen to be, are instantly abandoned, and the larves destroyed. Reaumur must therefore have mistaken the result of his own experiments, when he asserts, that a stranger queen is instantly well received, though presented at the moment when the other is withdrawn. He had seen the bees crowding around her at the entrance of the hive, and laying their antennas over her; and this he seems to have taken for caressing. The structure of the hives he employed prevented him from seeing further: had he used the leaf-hive, or one of similar construction, he would have perceived that the apparent caresses of the guards were only the prelude of actual imprisonment.

It is well known, that after the season of swarming, a general massacre of the drones is commenced. Several authors assert in their writings, that the workers do not sting the drones to death, but merely harass them till they be banished from the hive and perish. M. Huber contrived a glass table, on which he placed several hives, and he was thus able to see distinctly what passed in the bottom of the hive, which is generally dark and concealed: he witnessed a real and furious massacre of the males, the workers thrusting their sting so deep into the bodies of the defenceless drones, that they were obliged to turn on themselves as on a pivot, before they could extricate them. The work of death commenced in all the hives much about the same time. It is not, however, by a blind or indiscriminating instinct that the workers are impelled thus to sacrifice the males; for if a hive be deprived of its queen, no massacre of the males take place in it, while the hottest persecution rages in all the surrounding hives. In this case, the males are allowed to survive the winter. Mr. Bonner had observed this fact; he supposed, however, that the workers thus tolerated the drones for the sake of the additional heat they gene-

rated in the hive; but we now see the true reason to be, that their aid is needed to impregnate a new queen. The drones are also suffered to exist in hives that possess fertile workers, but no proper queen; and, what is remarkable, they are likewise spared in hives governed by a queen whose impregnation has been retarded. Here, then, we perceive a counter instinct opposed to that which would have impelled them to the usual massacre.

M. Huber next investigates whether the queen be really oviparous; and this point he clearly ascertains in the affirmative.

He then states the different periods at which the transformations occur, in the case of the different orders of queen, worker, and drone; and his information being minute, and no doubt correctly accurate, we shall extract it.

"The worm of workers passes three days in the egg, five in the vermicular state, and then the bees close up its cell with a wax covering. The worm now begins spinning its coccoon, in which operation thirty-six hours are consumed. In three days it changes to a nymph, and it passes six days in this form. It is only on the twentieth of its existence, counting from the moment the egg is laid, that it attains the fly state. The royal worm also passes three days in the egg, and is five a worm; the bees then close its cell, and it immediately begins spinning the coccoon, which occupies twenty-four hours. The tenth and eleventh day it remains in complete repose, and even sixteen hours of the twelfth. Then the transformation to a nymph takes place, in which state four and one-third days are passed. Thus, it is not before the sixteenth day that the perfect state of queen is attained. The male worm passes three days in the egg, six and a half as a worm, and metamorphoses into a fly on the twenty fourth day after the egg is laid."

The author then examines the effects of position on the growth of the larves. The bodies of the larves, in the cells of workers and drones, are placed perpendicularly to the horizon; those in royal cells lie horizontally. It was suspected that the horizontal posture somehow promoted the increment of the royal grub; but M. Huber found, that a complete reversal of the position was followed by no perceptible consequence to the larves.

Workers and drones both spin complete coccoons, or enclose them on every side. Royal larves, however, construct only imperfect coccoons, open behind, and enveloping only the head,

thorax, and first ring of the abdomen. M. Huber concludes, without any hesitation, that the final cause of the royal larves, forming only incomplete coccoons, is, that they may thus be exposed to the mortal sting of the first hatched queen, whose instinct leads her instantly to seek the destruction of those that would soon become her rivals; and he calls upon us to admire the providence of nature, in thus exposing the royal larves to fatal danger.

In the close of the letter, we have an account of an experiment instituted to determine the influence which the size of the cells might have on the size of the bees produced in them. All the larves were removed from a comb of drone's cells, and the larves of workers substituted in their place. The bees, it may be remarked, immediately shewed that they were aware of the change which had been effected; for they did not close the cells with the convex covering always placed over the males, but gave them quite a flat top. The result proved, that the size of the cells does not materially influence the size of the bees; or, at least, that although a small cell may cramp the size of the worker, yet, that workers bred in large cells do not exceed the ordinary bulk.

Upon the subject of swarming, M. Huber commences with an interesting account of the hatching of the queen-bee. When the pupa is about to change into the perfect insect, the bees render the cover of the cell thinner, by gnawing away part of the wax; and with so much nicety do they perform this operation, that the cover at last becomes pellucid, owing to its extreme thinness. This must not only facilitate the exit of the fly, but M. Huber remarks, it may possibly be useful in permitting the evaporation of the superabundant fluids of the nymph. After the transformation is complete, the young queens would, in common course, immediately emerge from their cells, as workers and drones do; but the bees always keep them prisoners for some days in their cells, supplying them in the mean time with honey for food; a small hole being made in the door of each cell, through which the confined bee extends its proboscis to receive it. The royal prisoners continually utter a kind of song, the modulations of which are said to vary. The final cause of this temporary imprisonment, it is suggested, may possibly be, that they may be able to take flight at the instant they are liberated. When a young queen at last gets out, she meets with rather an aukward reception; she is pulled, bitten, and

chased, as often as she happens to approach the other royal cells in the hive. The purpose of nature here seems to be, that she should be impelled to go off with a swarm as soon as possible. A curious fact was observed on these occasions; when the queen found herself much harrassed, she had only to utter a peculiar noise, (the commanding voice, we may presume, of sovereignty) and all the bees were instantaneously constrained to submission and obedience. This is, indeed, one of the most marked instances in which the queen exerts her sovereign power. It seems entirely to have escaped the notice of Mr. Bonner, who declares that he never could observe in the queen any thing like an exertion of sovereignty.—Yet the language of hive bees in general has been observed and noticed by Mr. Kirby, and many earlier writers.

The conclusions at which M. Huber arrives on the subject of swarms are the following.

1st. "A swarm is always led off by a single queen, either the sovereign of the parent hive, or one recently brought into existence. If at the return of spring, we examine a hive well peopled, and governed by a fertile queen, we shall see her lay a prodigious number of male eggs in the course of May, and the workers will choose that moment for constructing several royal cells." This laying of male eggs in May, M. Huber calls the great laying; and he remarks, that no queen ever has a great laying till she be eleven months old. It is only after finishing this laying, that she is able to undertake the journey implied in leading a swarm; for previously to this "*latum trahit alvum*," which unfits her for flying. There appears to be a secret relation between the production of the male eggs and the construction of royal cells. The great laying commonly lasts thirty days: and regularly on the twentieth or twenty-first several royal cells are founded.

2dly, "When the larves hatched from the eggs laid by the queen in the royal cells are ready to transform to nymphs, this queen leaves the hive, conducting a swarm along with her; and the first swarm that proceeds from the hive is uniformly conducted by the old queen." M. Huber remarks, that it was necessary that instinct should impel the old queen to lead forth the first swarm; for that she being the strongest, would never have failed to have overthrown the younger competitors for the throne. An old queen, as has already been said, never quits a hive at the

head of a swarm, till she have finished her laying of male eggs; but this is of importance, not merely that she may be lighter and fitter for flight, but that she may be ready to begin with the laying of workers' eggs in her new habitation, workers being the bees first needed in order to secure the continuance and prosperity of the newly-founded commonwealth.

3dly, " After the old queen has conducted the first swarm from the hive, the remaining bees take particular care of the royal cells, and prevent the young queens, successively hatched, from leaving them, unless at an interval of several days between each." Under this head he introduces a number of general remarks, some of which may prove useful. " A swarm," he observes, " is never seen, unless in a fine day, or, to speak more correctly, at a time of the day when the sun shines, and the air is calm. Sometimes we have observed all the precursors of swarming, disorder and agitation; but a cloud passed before the sun, and tranquillity was restored; the bees thought no more of swarming. An hour afterwards, the sun having again appeared, the tumult was renewed; it rapidly augmented; and the swarm departed." A certain degree of tumult commences as soon as the young queens are hatched, and begin to traverse the hive: the agitation soon pervades the whole bees; and such a ferment then rages, that M. Huber has often observed the thermometer in the hive to rise suddenly from about 92° to above 104°: this suffocating heat he considers as one of the means employed by nature for urging the bees to go off in swarms. In warm weather, one strong hive has been known to send off four swarms in eighteen days.

4thly, " The young queens conducting swarms from their native hive are still in a virgin state." The day after being settled in their new abode, they generally set out in quest of the males, and this is usually the fifth day of their existence as queens. Old queens conducting the first swarms, require no renewal of their intercourse with the male, a single interview being sufficient to fecundate all the eggs that a queen will lay for at least two years. This is considered by Mr. Bonner as quite an incredible circumstance; insomuch that he remarks, either in a sarcastic or in a very innocent style, that if a queen-bee " should continue for seven or eight months with about 12,000 impregnated eggs in her ovarium, it certainly would make her appear very large!" The worthy bee-master seems to have

fancied that an egg could not be fecundated till it were of the full size, and ready for exclusion. It is a fact, however, ascertained beyond controversy by M. Hubert, that "a single copulation is sufficient to impregnate the whole of the eggs that a queen will lay in the course of at least two years. I have even reason to think," he adds, "that a single copulation will impregnate all the eggs that she will lay during her whole life; but I want absolute proof for more than two years."

On the wonderful instinct of bees M. Huber is duly cautious. He resolves all into what Shakespeare calls a "ruling nature;" and disapproves both of Reaumur for ascribing wisdom and foresight to them, and of Buffon for considering them as mere automata.

The instinct of such queens as lay only the eggs of drones, or whose fecundation has been retarded, seems to be impaired: they shew no antipathy to royal cells, but pass quietly over them without indicating any emotion, while other queens exhibit the greatest enmity against those of their own sex that are in the nymphine state. Swammerdam had asserted, that if the wings of queens be cut, they are rendered sterile. This appeared rather strange and improbable. M. Huber accordingly found, that the cutting of the wings of impregnated queens produced no effect on them; and he concludes, certainly with great probability, that Swammerdam had cut the wings of virgin queens, who had not therefore been able to seek the males in the air, and so remained barren. The amputation of one antenna, M. Huber found, had no bad effect on a queen; but when deprived of both, she was much deranged: she dropped her eggs at random; and when the bees fed her, she often missed her aim in attempting to catch hold of the morsel they presented to her. M. Huber placed two queens deprived of the antennas in the same hive: the loss of their feelers seemed to have put an end to their natural animosity; they passed and repassed each other without taking the least notice. Both of them constantly endeavoured to leave the hive. M. Huber declares, that he cannot say whether the antennas be the organ of touch or of smell; but he suggests that they may probably fulfil both functions at once. It seems fully as possible that they are the instruments of a peculiar sense, of the nature of which we have no conception, and for which, consequently, we have no name.

We have already hinted that M. Huber's leaf-hive might be em-

ployed with advantage by practical men. It is well calculated, for example, for producing artificial swarms, on the principle of Schirach's discovery. "In the leaf-hive," says he, "we can see whether the population be sufficient to admit of division,—if the brood be of proper age,—if males exist, or be ready to be produced for impregnating the young queen." By means of it, also, bees may be induced to work much more in wax than they would naturally do. "Here," continues M. Huber, "I am led to what I believe is a new observation. While naturalists have directed our admiration to the parallel position of the combs, they have overlooked another trait in the industry of bees, namely, the equal distance uniformly between them. On measuring the interval separating the combs, it will generally be found about four lines. Were they too distant, it is very evident the bees would be much dispersed, and unable to communicate their heat reciprocally; whence the brood would not be exposed to sufficient warmth. Were the combs too close, on the contrary, the bees could not freely traverse the intervals, and the work of the hive would suffer*." This instinct being admitted, it is evident that bees may be induced to construct new combs, by merely separating those already built so far asunder that they may have room to build others in the interval.

The cause of the bees, which has been so eloquently and pathetically pleaded by the Poet of the Seasons, is supported by M. Huber on a principle more intelligible perhaps, and more persuasive, to most country bee-masters, viz. interest. He deprecates the destruction of bees, and recommends to the cultivator to be content with a reasonable share of the wealth of the hive; arguing very justly, we believe, that a little taken from each of a number of hives, is ultimately much more profitable than a greater quantity obtained by the total destruction of a few.

[*Phil. Trans. J. Hunter. Shaw. Bonner. Huber. Pantologia. Edin. Rev.*

* Nouvelles Observations sur les Abeilles, par Francois Huber.—Manuel-pratique de la Culture des Abeilles.—Histoire Naturelle de la Reine des Abeilles.—New Plan for speedily increasing the number of Bees, &c. by James Bonner. Edinburgh Review, No. xxii. p. 319.

SECTION XIV.

Common Ant.

Formica nigra.—Linn.

It is to the minute and indefatigable attention of the younger Huber (son of the preceding) that we know any thing of the actual history of this curious and extraordinary insect. We shall extract his history, as we meet with it in an abridged form in the article Zoology, of the Pantologia.

The industry and activity of ants had attracted much notice from the ancients; but in the mixture of truth and fable which compose the accounts of Pliny, and of Aristotle, we find the errors greatly preponderating; and even the writings of modern naturalists contain a multitude of vague assertions, unsupported by observations. By some their sagacity has been greatly exaggerated, and by others as unwarrantably depreciated. Leuwenhoek rectified many of the errors, and was the first who accurately distinguished the larves from the eggs. Swammerdam followed them, with still greater minuteness, in all their transformations; and Linnæus made us acquainted with several curious particulars respecting these insects in the state of fly, which we shall afterwards have occasion to notice. The labours of Geoffroy, De Geer, Bonnett and Latreille, have added numerous facts on the economy of ants, but still left many important questions undecided, to which the more successful efforts of M. Huber have now given a satisfactory solution. In his account of the external characters of the species, which forms the introduction to his work, he avails himself principally of the descriptions and method of Latreille. He agrees with him in ascribing to them a tongue, an organ which Fabricius had supposed them not possessed of. This tongue is spoon-shaped; and by means of it, the insect, according to M. Huber, is enabled to lap up fluids with the greatest facility. He has discovered no less than twenty-three species indigenous in Switzerland; but the particulars he has given us relate to a few of these only.

Ants present us with many striking analogies with bees; as in them, we may in each species distinguish three modifications of sex, namely, the *males*, the *females*, and the *neuters* or *labourers*; the latter being with respect to sex, in the same condition as the

working bees; that is, they are females in whom the generative organs are not developed, and who of course are barren. In each hive of bees, however, there is but one queen; whereas a great number of queens, or female ants, are met with, living in the utmost harmony in the same nest. It appears, that any of the larves of the labouring class of bees may be raised to the rank of queen; that is, may acquire a development of organs by a particular mode of feeding. Whether the same circumstance obtains, with respect to the female ant, has not yet been ascertained, and is a question which Mr. Huber's future researches will probably enable him to determine. The various toils which contribute to the welfare of the republic are confided, in both communities, to the labourers, who act as the architects of the city, as the soldiers of the garrison, and as the nurses and guardians of the rising generation; while the other classes have no other duties to perform than those of furnishing recruits to the colony.

The different species of ants, like the nations of our own species, are distinguished from each other by great diversities of manners. This is strikingly shown in the variety of modes in which they construct their habitations. Some employ merely earth as the material; some collect for the same purpose fragments of leaves, of bark, or of straw; others use nothing but finely pulverised portions of decayed wood. The solid substance of trees is excavated by another species into numerous apartments, having regular communications with one another. Various other modifications may be observed in the architecture of the different species. The most perfect specimens of workmanship are generally exhibited by the smaller ants. The brown ant *(fourmi brune)* is particularly remarkable among the masonic tribes. Their nests are formed of parallel or concentric stories, each four or five lines in height; the partitions being about half a line in thickness, and built of such fine material that the interior appears perfectly smooth. On examining each of these stories, we discover chambers of different sizes, having long galleries of communication. The ceilings of the larger spaces are supported by small pillars, sometimes by slender walls, and in other cases by arches. Some cells have but a single entrance; others have passages, which open from the story underneath. In other parts, still larger central spaces, or halls, are met with, in which a great number of passages terminate, like the

streets and avenues to a market-place. The whole nest often contains twenty of these stories, above the level of the ground, and at least as many below it. The use of this numerous series of rooms will appear in the sequel. The surface of the nest is covered with a thicker wall, and has several doors admitting, in the day-time, free ingress and egress. This species of ant is unable to bear much heat. During the day, therefore, and particularly when the sun shines, their doors are closed; and they either keep at home, or venture out only through the subterraneous passages. When the dew has given freshness to the nest, and softened the earthy materials on its surface, they begin to make their appearance above ground. On the first shower of rain that occurs the whole swarm are apprised of it, and immediately resume their architectural labours. While some are engaged in moving the earth below, others are employed in building an additional story on the top; the masons making use of the materials furnished by the miners. The plan of the cells and partitions is first traced in relief on the walls, which are seen gradually to rise, leaving empty spaces between them. The beginnings of pillars indicate the situation of the future halls; and the rising partitions show the form of the intended passages. Upon the plan thus traced, they continue building, till they have arrived at a sufficient elevation. Masses of moistened earth are then applied at right angles to the tops of the walls, on each side, and continued in a horizontal direction till they meet in the middle. The ceilings of the larger chambers are completed in the same manner; the workers beginning from the angle of the walls, and from the tops of the pillars which have been raised in the centre. The largest of these chambers, which might be compared to the town-hall, and is frequently more than two inches in diameter, is completed with apparently as much ease as the rest. This busy crowd of masons arriving in every direction, laden with materials for the building, hastening to avail themselves of the rain to carry on their work, and yet observing the most perfect order in their operations, must present the most interesting and amusing spectacle. They raise a single story in about seven or eight hours, forming a general roof as a covering to the whole; and they go on, adding other stories, so long as the rain affords them the facility of moulding the materials. When the rain ceases, and is succeeded

by a drying wind, before they have completed their work, the earth ceasing to adhere together, and crumbling into powder, frustrates all their labours; as soon as they find this to be the case, they, with one accord, set about destroying the cells which they have begun, but had not been able to cover in, and distribute the materials over the upper story of what they had completed. Under these circumstances, M. Huber succeeded in getting them to resume their task by means of an artificial shower.

In tracing the design of the cells and galleries, each ant appears to follow its own fancy. A want of accordance must therefore frequently take place at the point where their works join; but they never appear to be embarrassed by any difficulties of this kind. An instance is related, in which two opposite walls were made of such different elevations, that the ceiling of one, if continued, would not have reached above half way of the height of the other. An experienced ant arriving at the spot seemed struck with the defect, and immediately destroyed the lower ceiling, built up the wall to the proper height, and formed a new ceiling with the material of the former.

Nature, in providing the male and female ants with wings, must evidently have designed them for migration to distant abodes, where they might become the founders of new colonies. Arrived at the period of maturity, and furnished with perfect instruments of flight, they wait only till the warmth of the atmosphere is sufficiently genial; and do not quit their nests till the temperature has risen to above 67° of Fahrenheit. Busy swarms of these winged insects are then seen to issue from the nest, and to cover the neighbouring plants, expanding their wings, which reflect the sun's rays in a thousand brilliant colours. They are escorted in all their steps by the labourers, who appear to watch them with peculiar solicitude, frequently offering them food, and caressing them with their antennæ. At length they leave their attendants, and commence their flight, few being destined ever to return to the spot that gave them birth. The act of fecundation is generally performed during their flight. The males, having fulfilled the purpose of nature, are now useless members of the society: it does not however appear that they are ever massacred by the labourers, as is the case with drones; but they are left to perish for want of sustenance; being

unprovided with the means of procuring it for themselves, and being separated from those by whose bounty they had hitherto been fed. The females, when impregnated, seek proper habitations, where, as will afterwards appear, they lay the foundations of new republics.

All the impregnated females however are not lost, in this way, to the parent state: many are detained by the labourers before they can take their flight, and a few are impregnated in the nest itself. The labourers are every where lying in wait for them, and forcibly seize them wherever they are to be found; they immediately deprive them of their wings, and drag them to the nest. Here they are kept close prisoners for several days: their keepers watching them with the greatest assiduity, but carefully supplying them with nourishment, and conveying them to situations where the temperature is the most grateful.

The eggs, when first deposited, are very small, white, opaque, and of a cylindrical form. The labourers, to whom the care of hatching them is confided, never quit them for a moment, but keep them in a state of moisture, by licking them continually with their tongues, or passing them through their mouths. M. Huber has clearly proved that the eggs acquire a considerable increase of size during this period; and that at length they become nearly transparent, and much distended, and resemble in form the larve that is about to be excluded. A similar growth had already been noticed by Reaumur in the eggs of the gall insect, and by Vallisneri in those of some species of fly. At the end of a fortnight the larve comes forth; it is then perfectly transparent, consists only of a head and rings, without even the rudiments of feet or antennæ. In this state it is likewise completely dependent on the labourers for its support: their food is altogether liquid; and their nurses allow them to take it out of their mouths, without its appearing to have undergone any preparation. The following passage will give some idea of the care with which they are reared.

In their passage to the state of perfect insects they still require the fostering care of their guardians, and would be unable, without their help, to extricate themselves from their inclosure. In these efforts for their deliverance the labourers display surprising patience and ingenuity; and a lively picture is given of the scene that the interior of the nest presents to the spectator, while the whole soci-

ety of labourers are actually employed in emancipating the young from their fetters, and anticipating all their wants till they are able to provide for themselves. They still watch and follow them for many days, teaching them the ways and labyrinths of their habitation, and supplying them abundantly with food. They assist the males and females in expanding their wings, which would otherwise remain folded; and, whenever they wander to too great a distance, conduct them back in safety: and they continue these offices till the season of their migration is arrived.

The fecundated females that escape detention, and quit for ever after the paternal roof, no sooner alight upon a spot where any loose earth is to be met with, than they set about forming a habitation. The first step they take is to cut off their own wings, for which they have no longer any use: and it is extremely curious that they never perform this operation till they find a situation that promises to afford them an asylum. Having now no labourers to work for them, they perform all the household duties themselves. Like the mothers of other animals, they are indefatigable in their attontion to their offspring. Thus the same individual, which, when surrounded at home by those who minister to all her wants, and relieve her from exertion, would have reposed in indolence, and been quite careless of her young, acquires new powers from necessity, and fulfills the intention of nature in the formation of new republics. It is impossible to produce a more striking example of variation in the character of animals, produced by a change of external circumstances.

Our attention shall next be directed to the way in which ants procure the means of subsistence; and the views that have been opened to us by M. Huber on this subject are among the most curious of any he has disclosed. It is here, indeed, that the principal errors have been committed, by those who have hitherto pretended to instruct us as to the economy of these insects. The collections of larvæ were long mistaken for magazines of corn and other food, which it was supposed the ants deposited in granaries, as provisions for winter consumption. But the truth is, that they are almost wholly carnivorous, and corn is certainly not an article on which they feed: they are total strangers to the art of hoarding, and none of their cells are constructed with this view. The ants, whose occupations confine them at home, depend for their

food on the labourers, who forage for the whole society, and bring to the nest small insects, or portions of any animal substances that may fall in their way. When the game is too bulky to be easily transported, they fill themselves with nourishment, the greater part of which they disgorge on their return, for the benefit of those that are hungry. This nutritious fluid they retain unchanged for a considerable time, when prevented from imparting it to their companions.

The food which they appear to relish above all other is an exsudation from the bodies of several species of aphis, insects which abound on the plants in the vicinity of ant hills. This species of honey is absorbed with great avidity by the ants, and apparently without the least detriment to the insect that yields it. This fact had already been noticed by Boissier de Sauvages; but several very interesting particulars, as to the mode in which this excretion is procured, have been brought to light by M. Huber. He informs us, that the liquor is voluntarily given out by the aphis, when solicited to do so by the ant, who, for that purpose, strikes it gently, but repeatedly, with its antennas, using the same motions as it does when caressing its young. He is led to believe from observation, that the aphis retains this liquor for a long time, when the ants are not at hand to receive it. A single aphis is sufficient to supply in this way many ants with a plentiful meal. Even those among them who had acquired wings, and could therefore have easily escaped from the ants, if they had been so disposed, yielded this honey as freely as the others, and with as little appearance of fear or constraint.

Most insects become torpid when their temperature is much reduced. When it approaches the freezing point, they fall into a deep lethargy, and in that state require no food. Ants present a remarkable exception to this rule; for they are not benumbed till the thermometer has sunk to 70° of Fahrenheit, or five degrees below the freezing point. They therefore have need of a supply of provisions during the greater part of the winter; although it is true that they are satisfied with much less than in summer. Their principal resource, however, under these circumstances, is still the same, namely, the honey of the aphis; which natural secretion appears to be expressly designed for the subsistence of ants. What confirms this view of the intentions of nature is, that the aphis be-

comes torpid at precisely the same temperature as the ant; a coincidence which it is hardly possible to attribute to mere chance. The winter haunts of the aphis, which are chiefly the roots of trees and shrubs, are well known to their pursuers; and when the cold is not excessive, they regularly go out to seek their accustomed supply from these insects. Some species of ants have even such sufficient foresight to obviate the necessity of these journeys; they bring these animals to their own nests, where they lodge them near the vegetables on which they feed, while the domestic ants prevent them from stirring out, guarding them with great care, and defending them with as much zeal as they do their own young.

But their sagacity goes even much further than what is here related. They collect the eggs of the aphis, they superintend their hatching, continually moistening them with their tongue, and preserving them till the proper season for their exclusion, and in a word, bestow on them all the attention which they give to the eggs of their own species. When disturbed by an intruder, they carry off these eggs in great haste to a place of safety. Different species of aphis are to be found in the same nest: several kinds of gall insects, and also of kermes serve the same purposes to the ants as the aphis, affording them in like manner juices possessed of nutritious qualities. All these live in perfect harmony with their masters, who so far from offering them any molestation, defend them with courage against the ants of other societies who might attempt to purloin them. That the ants have some notion of property in these insects, would appear from their occasionally having establishments for these aphises at a distance from their city in fortified buildings which they construct for this purpose alone, in places where they are secure from invasion. Here the aphises are confined as cows in a dairy, to supply the wants of the metropolis.

Our author has been at great pains to ascertain by what means these insects are enabled to co-operate in the execution of these and other designs; a co-operation which is inexplicable, except on the supposition that they possess a species of language, by which the intentions of individuals are imparted to one another, and to the community at large. The particular means apparently used for this purpose are detailed in many parts of the work; and it might, we conceive, have been instructive to have brought together, in a distinct chapter, all the facts that bore upon this inter-

esting question. It does not appear that ants are capable of emitting sounds so as to communicate at a distance. The sense of touch is with them the principal medium of conveying impressions to one another. Some of these impressions are communicated by the one striking its head against the corselet of the other; others by bringing their mandibles in contact. The former is the signal of danger; which is spread with astonishin gquickness through the whole society. During the night, as well as at other times, sentinels are stationed on the outside of their habitations, who on the approach of danger suddenly descend into the midst of the tribe, and spread the alarm on every side; the whole are soon apprised of the danger; and while the greater number rush forward to repel it, with every expression of displeasure and of rage, the rest, that are attending the eggs and larves, hasten with their charge to places of greater security. The males and females, on the other hand, on being warned of the approaching combat, in which they feel themselves incapable of bearing any active part, fly for shelter to the most retired places in the vicinity.

Bonnett had imagined, that in their journeys ants directed their course chiefly by the scent remaining in the track which they had before passed. But it appears that they have various other means of finding their way; and must depend principally on the senses of sight and of touch, aided by the memory of local circumstances. If they should meet with annoyance in their nest, or from any other cause find it inconvenient to remain, they endeavour to find some other spot to which they may remove; and, for this purpose, the labourers scatter themselves abroad, and reconnoitre in every direction. The ant who has the good fortune to discover a convenient situation returns immediately home, and by certain gestures acquaints her comrades with her success, and points out the direction of the place she has chosen. The migrations of the fallow ants (*fourmis fauves*) are conducted in a very singular manner. The guide carries another ant in her mouth, to the place to which she intends the colony to remove. Both then return, and each taking up another ant, bring them, in a similar manner, to the new settlement. These, when instructed in the way, return and fetch others; and this process is continued by all the guides, their numbers increasing in rapid progression till the whole has been transported to the new place of abode.

It is impossible to contemplate the actions of such minute beings, in whom not only all the parental affections subsist in as full force as in the larger animals, but the social sympathies also prevail in a much more extraordinary degree, without feelings of wonder and admiration. The zeal with which the bee will devote its life to the service of the community of which it forms a part has long been known; but the ant is not inferior to the bee, either in courage or in patriotism; and, moreover, bears testimony, by unequivocal actions, of a degree of tenderness and affection, which we can hardly bring ourselves to conceive could animate a being of a condition so apparently inferior. Latreille, in the course of his experiments, had deprived some ants of their antennæ: their distress was no doubt perceived and shared by their companions, who caused a transparent liquor, which probably possessed some healing properties, to flow from their own mouths, and with this they anointed the wounds of the sufferers. Many traits of their fondness, and tender care of their females, were witnessed by the author; they give the most remarkable proof of the permanence of their affection when any of the impregnated females happen to die; in which case, five or six of her attendants remain with her for many days, licking and caressing the body without intermission, as if they hoped to recal her to life by their caresses. Many anecdotes are related by M. Huber of their readiness to assist one another, and of their manifesting a desire that their companions should participate in the advantages, and enjoyments that occurred to themselves.

While ants thus enjoy all the advantages of a state of civilization, they are not exempt from the passions that disturb domestic peace, and the evils that interrupt the harmony of social life. Can it be that war, with its attendant calamities, is the necessary concomitant of society; and must it also be the scourge of communities among insects, as well as among beings who pride themselves in such superior endowments? It is but too true that the history of ants affords no exception to this apparent connexion of things. The almost Utopian picture of a republic, which the preceding accounts exhibit, is deformed by features of ferocity which blend themselves with the estimable qualities we have described. In the hostilities of animals we generally find a mixture of stratagem and of force; and they consist almost wholly in occasional struggles

between individuals who prey upon one another. But the modes of warfare pursued by ants is of a totally different character. Their aggressions are made by large armies; and their battles are general engagements between contending nations. The wars they wage are always open and direct, and exhibit none of the arts of deceit; their operations are conducted on a scale of magnitude that is astonishing. The labourers and the females are the only ants that engage in these conflicts. Some species are provided with stings; others employ their jaws in the infliction of wounds, and apply to the bitten part a drop of acid fluid, which is secreted for this purpose. Their combined attacks upon various insects, even of considerable size, are well known. In hot climates they extend their hostilities to the smaller quadrupeds, such as rats; and, in some countries, become formidable even to man. But the greatest enemy to the ant is the ant itself. The lesser are frequently enabled, by their courage as well as by superior numbers, to overpower the stronger species; and jealousies often spring up between rival states belonging to the same species. Each has its peculiar system of tactics, which is varied according to the enemy to whom they are opposed. The fury and desperation with which they fight is inconceivable. When an ant has fastened upon his adversary, it will suffer its limbs to be torn, one by one, from its body, rather than let go its hold; and they are frequently seen to carry about with them, as trophies of their victories, the mangled portions of those they have subdued. The theatres of the most extended engagements are the forests inhabited by the fallow ants.

There is one species of large ants which M. Huber denominates Amazones, who inhabit the same nests with an inferior species, namely, the dark ash-coloured ant, (*noir cendrée*), and whom we may call their auxiliaries. As soon as the heat of summer has set in, the amazons muster their forces; and, leaving the auxiliaries to take care of the nest, march out in regular order, sometimes dividing their forces into two expeditions, but generally proceeding in one united army to the point of attack, which is always a nest belonging to ants of the same species as the auxiliaries with whom they live. These resist the aggression with great courage; but are soon compelled to fly from the superior force of the invaders, who enter at the breach they have made, and pro-

ceed to plunder the nest of all the eggs and larves which they can carry off. They return laden with this booty to their own habitations, and consign it to the care of the ash-coloured ants belonging to their community, who are waiting in eager expectation to receive them. These eggs and larves are watched, nourished, and reared to maturity, with the same care and assiduity which the auxiliaries bestow on their own progeny; and thus they become, in process of time, inmates in the same society with those who had originally kidnapped them; and towards whom, had they been brought up at home, they would have cherished an instinctive and inveterate hatred. The sole object of the amazons in these expeditions, is to procure this supply of recruits for the advantage of the community to which they belong; and the sole business of their lives is to carry on these marauding adventures. They do not assist in any of the ordinary labours of the community. The tasks of building and repairing their city, of providing nourishment for the whole society, of rearing the brood of young, both of their own species and that of their companions, are entrusted solely to the race of auxiliaries, to whose services they have become entitled by the right of conquest. In times of peace the amazons are totally inactive, and dependent on the labouring classes of the auxiliaries, who feed and carress them, minister to all their wants, and carry them wherever the temperature of the air is most grateful. In a word, they are gentlemen waited on by their domestics, who appear to retain no sense of the injury that has been done them by their masters, but bear towards them the tender affection of children towards their parents. The more cruel relation of master and of slave seems, indeed, to be entirely excluded from this singular association of insects. In order to have a just idea of the complex system it involes, we must recollect, that each species consists of three kinds of sexes, having perfectly distinct offices to perform: that each insect exists in three different stages of transformation; and that, in addition to the race of ants, several species of aphis are also inmates under the same roof. In some nests, our author found auxiliary ants of different species from the ash-coloured, being what he called miners (*mineuses*), but still bearing, in all respects the same relations to the amazons that the ash-coloured did in the former case, and obtained from their parents by the same violent methods.

The amazons are not the only ants that carry on this species of slave-trade; the sanguine ants (*fourmis sanguines*) having offered analogous facts with those above related. The author even discovered nests in which the sanguine ants are attended by both the above-mentioned species of auxiliaries; thus forming a triple association of races of ants, having very different manners and habits, but concurring in the same objects of necessary industry. For the particular circumstances of these discoveries, we must refer our readers to the work itself, which will amply repay the curiosity of those who peruse it.

The facts disclosed in this volume of researches are too extraordinary not to render us, at first sight, suspicious of the evidence on which they are advanced; and will naturally raise a doubt whether the narrative has not received too much embellishment from the colouring of a warm imagination. Upon a more strict examination, however, we do not think there exists any reasonable ground for such suspicions: the facts are stated with sufficient distinctness to justify our placing full confidence in their accuracy, independently of the known character of the author, who relates them. He every where states what he has himself seen, and what others might verify by following the same methods of observation. Although many naturalists have already studied the history of ants, yet much discordance and obscurity has prevailed with regard to many essential points in their economy; a circumstance that has arisen from their never having been able to see what was going on in the interior of the nests, which is the scene of the most important and interesting features of their history. To M. Huber belongs the merit of inventing an apparatus, and method of observation, which bring within view all the operations which these insects had hitherto conducted in secret. The difficulties he had to contend with, in contriving a glass case which would admit the light into their apartments, without alarming or disturbing them in their employments, were at first great, but by perseverance were at length overcome. Even methods which succeeded for a time were frequently defeated by the sagacity of these insects, who are extremely jealous of intruders, exquisitely sensible to all variations of temperature, and always alarmed at the presence of light in their subterraneous abodes. At last, by placing

wooden boxes with glass windows, in which he had introduced a nest of ants, on a table in his study, and keeping them prisoners, by immersing the feet of the table in buckets of water, he was enabled to make them the subject of continued observation, and vary his experiments on the same individuals. Habit and the experience that no evil was intended, gradually reconciled the ants to the visits of their inspector. By comparing the results of these observations and experiments with similar ones made on the same species of ants in their natural state of freedom, he satisfied himself that perfect reliance could be placed on their accuracy.

The facts which have thus been brought to light are not valuable merely as supplying chasms in the history of a single genus of insects; they are of importance, in as far as they point to more general views of the faculties of the lower animals, and to the solution of some of the questions with regard to instinct, to which we formerly adverted. On a superficial comparison of the actions of animals with those of our own species, much apparent resemblance may be traced; but on examining them with more attention, with respect to the source from which they are derived, the analogy becomes much more weak, and the difficulty of explaining the greater number has been so considerable, that many philosophers have cut the knot, by referring generally the actions of man to reason, and those of brutes to instinct. It was pretended, that their faculties differed not merely in degree but in kind; and that, in a word, there existed between them no principle in common. Observation must, however, convince us, that the lower animals exert, in many instances, a choice of means for accomplishing their ends; and that they are capable of a degree of combination of those means, conformable with the variation of external circumstances. It is obvious, that actions prompted by mere appetite, which is the direct result of organization producing pain or pleasure, cannot be properly termed instinctive, at least, in the sense in which instinct is opposed to reason. Still less can it be said that instinct is the source of those actions which procure the means of gratifying appetite, when their effect in procuring those gratifications is already known to the individual who employs them. Knowledge, therefore, as far as it goes, excludes instinct. Now this knowledge may be either acquired by personal experience, or it may

be derived from the tradition of others; and innumerable instances occur in which animals acquire, in both ways, that kind of knowledge that influences their conduct. But the term instinct has also been applied to actions resulting from knowledge not derived from either of these sources, that is, from innate knowledge. There are many facts, indeed, which prove, that the avenues to some species of knowledge are in animals different from what they are with us. The kid, the moment after it is dropped, and antecedent to all experience, shows us plainly, by its movements, that it knows at once, and without the long chain of inductive reasoning which Berkeley assigns as the source of our acquired perceptions of sight, the distances and situations of the objects which are placed before it.

It is to those actions alone that lead to beneficial consequences unforeseen by the agent, and not resulting from any knowledge of the effects they produce, that the term instinct is more peculiarly appropriated. Thus, the sagacity of the bird, which, though it was unfledged when taken from its parent, will yet construct at a proper time a nest for its own young, and will sit over its eggs with unwearied constancy, while we must suppose it unacquainted with the future pleasures that will be the reward of these exertions, and even unconscious of their object, is properly said to be derived from instinct. Could we succeed in assigning a motive to these actions, we should redeem them from this class, and recognise their place in some other. To this object have the efforts of Darwin, and other contemplative naturalists, been directed; but the attempts too often fail, from their being the offspring of fanciful conjecture, instead of the results of cautious induction.

Many of the phænomena brought to light by M. Huber receive, however, a much simpler explanation on the principle of real foresight in the agents themselves, founded on acquired knowledge, than on any other supposition. There is a circumstance in the history of these insects, that is at variance with all our preconceived notions of the stationary condition of the races of inferior animals. The amazons, whose republics, like those of other ants, are descended from one parent stock; and who, in the infancy of their several colonies, must have performed all the duties of labourers in maintaining their families; when, in process of time, their numbers have increased, and probably when whole genera-

tions have passed away, become capable of acquiring new habits and characters by the advantages of their condition. They are enabled to procure auxiliaries, and they desist altogether from their former labours. We see, in like manner, the instincts of these auxiliaries reversed, by being brought up in the society of their natural oppressors, and their animosities giving place to a state of the most friendly alliance.

The descriptions of these same animals in other climates, sufficiently shew what formidable power they acquire when the efforts of numbers are combined. Mr. Malouet mentions in his account of his travels through the forests of Guyana, his arriving at a savannah, extending in a level plain beyond the visible horizon, and in which he beheld a structure that appeared to have been raised by human industry. M. de Prefontaine, who accompanied him in the expedition, informed him that it was an ant hill, which they could not approach without danger of being devoured. They passed some of the paths frequented by the labourers, which belonged to a very large species of black ants. The nest they had constructed, which had the form of a truncated pyramid, appeared to be from fifteen to twenty feet in height, on a base of thirty or forty feet. He was told that when the new settlers, in their attempts to clear the country, happened to meet with any of these fortresses, they were obliged to abandon the spot, unless they could muster sufficient forces to lay regular siege to the enemy. This they did by digging a circular trench all round the nest, and filling it with a large quantity of dried wood, to the whole of which they set fire at the same time, by lighting it in different parts all round the circumference. While the entrenchments are blazing, the edifice may be destroyed by firing at it with cannon; and the ants being by this means dispersed, have no avenue for escape, except through the flames, in which they perish. The narrations of Mr. Smeathman, relative to the white ant of Africa, are also calculated to raise our ideas of the magnitude of these republics of insects, which must surpass the largest empire in the numbers of their population.

The superiority of the faculties of ants has been traced to the strength of the social disposition which unites them. We might perhaps venture a step farther, and point our several circumstances in their physical condition, as the probable origin of this disposition to associate together. These are to be found, first, in the delicacy

of their perceptions, in which they appear to excel most insects. They are, as we have seen, extremely sensible to variations of temperature, and generally averse to moisture. In the first stages of their existence, they are formed so as not to be capable of resisting the ordinary action of the air, and being totally helpless, would speedily perish, if left to themselves; and we have seen what assiduous and persevering care is required during the whole period of the hatching of the eggs, and the progress of the larve to maturity. All these circumstances place the young for a much longer time in a state of dependence upon their natural protectors, than in the case of most other insects: and in all these circumstances they agree with the bee and the wasp, which are alike gregarious. We recognise in our own species the foundation that is laid for the ties of society, by the helpless condition of the infant, which continues for so long a period to be dependent on others; and can we refuse to admit the operation of a similar principle in other departments of the animal creation, which are obedient to the laws which the same Providence has ordained for the good of all?

Greater varieties unquestionably occur in the conditions of animals than most philosophers have been willing to allow; and it must be confessed, that in spite of all our efforts at philosophical distinctions, the various kinds of actions of animals pass into one another by such imperceptible shades, and their sensitive existence differs so widely from our own, that we have properly no measure by which to fathom their reasoning powers. As well might we hope to discover the origin of the *punctum saliens* in the incubated egg, as to determine the point where the dawn of intellect appears, or assign the boundary where instinct assumes the form of reason. Nothing is simple in nature; all that we see is the effect of prodigious art: means are accumulated for the production of remote ends, in a series extending far beyond the sphere of our limited optics. We can discern clearly but a few of the final causes in nature, and but a few of the powers that operate in their accomplishment.

[*Pantolog. Edinb. Rev. Huber's Recherches sur les Moeurs des Fourmis Indigènes.*

SECTION XV.

Spider.

Aranea.—Linn.

The very extensive genus Aranea may be distributed into several sections, according to the habit or shape of body, or according to the position of the eyes, which are differently placed in the different families. We shall at present however mention only a few of the most remarkable species, without any particular division of the genus.

One of the largest of the European spiders is the *Aranea Diadema* of Linnæus, which is extremely common in our own country, and is chiefly seen during the autumnal season in gardens, &c. The body of this species, when full grown, is not much inferior in size to a small hazel nut: the general colour of the animal is deep chesnut-brown, approaching to reddish in some specimens; and the abdomen is beautifully marked by a longitudinal series of round or drop-shaped milk-white spots, crossed by others of similar appearance, so as to represent in some degree the pattern of a small diadem. This spider, in the months of September and October, forms, in some convenient spot or shelter, a large round, close, or thick web, of yellow silk, in which it deposits its eggs, guarding the round web with a secondary one of a looser texture. The young are hatched in the ensuing May, the parent insects dying towards the close of Autumn. The male of this species is distinguished by having the back crossed by four or five black-brown bars. The aranea diadema being one of the largest of the common spiders, serves to exemplify some of the principal characters of the genus, in a clearer manner than most others. At the tip of the abdomen are placed five * papillæ or teats, through which the insect draws its thread; and as each of these papillæ is furnished with a vast number of foramina or outlets, disposed over its whole surface, it follows that what we commonly term a spider's thread is in reality formed of a collection of a great many distinct ones; the animal possessing the power of drawing out more or fewer at

* In some species four; and in some are two smaller papillæ, the nature of which is doubtful.

pleasure; and if it should draw from all the foramina at once, the thread might consist of many hundred distinct filaments. The eyes, which are situated on the upper part or front of the thorax, are eight in number, placed at a small distance from each other, and having the appearance of the stemmata in the generality of insects. The fangs or piercers, with which the animal wounds its prey, are strong, curved, sharp-pointed, and each furnished on the inside, near the tip, with a small oblong hole or slit, through which is evacuated a poisonous fluid into the wound made by the point itself, these organs operating in miniature on the same principle with the fangs in poisonous serpents. The feet are of a highly curious structure; the two claws with which each is terminated being furnished on its under side with several parallel processes, resembling the teeth of a comb, and enabling the animal to dispose and manage, with the utmost facility, the disposition of the threads in its web, &c.

Aranea Tarantula, or Tarantula Spider, of which so many idle recitals have been detailed in the works of the learned; and which even to this day continues, in some countries, to exercise the faith and ignorance of the vulgar, is a native of the warmer parts of Italy, and other warm European regions, and is generally found in dry and sunny plains. It is the largest of all the European spiders, and is of a brown colour, with the back of the abdomen marked by a row of trigonal black spots with whitish edges, and the legs marked beneath by black and white bars. In the present illuminated period it may be sufficient to observe, that the extraordinary symptoms supposed to ensue from the bite of this insect, as well as their supposed cure by the power of music alone, are entirely fabulous, and are now sufficiently exploded among all rational philosophers.

Aranea nobilis is a very beautiful species, of middling size, with an orange-coloured thorax, marked by six black spots, and an oval yellow abdomen, with seven oval black spots, the first of which is situated immediately behind the thorax, while the remainder are disposed into two longitudinal rows: the legs are yellow, with the last joints black. This elegant spider is a native of Samaria.

Aranea scenica is a small species, by no means uncommon during the summer months, and generally seen on walls in gardens, &c. it is of a black colour, with the abdomen marked on

each side the upper part by three white bars. This spider is one of those which spring suddenly, to some distance, on their prey.

Aranea extensa is a smallish species, of a fine green colour, accompanied by a slight silvery gloss: it is common in gardens, and is almost always seen with the legs extended, in a parallel line with the body.

Aranea lævipes is of a grey colour, varied with minute black specks, and with the legs beautifully crossed by numerous alternate black and white bars.

Aranea palustris is of a lengthened form, and of a brown colour, and is principally seen in damp or watery places.

Aranea aquatica is a middle-sized species, of a deep chesnut-colour, residing entirely under water, generally in very clear ponds or fountains, and forming for itself a small tissue or web confining a proper quantity of air: sometimes this species is observed to take possession of a vacant shell, in which case it closes the mouth with a slight web.

The exact distinction of species in this genus, especially among the smaller kinds, is often extremely difficult and uncertain; since the animals are sometimes differently marked during the different periods of their life: some however are in this respect perfectly constant, bearing the same distribution of colours from their first hatching to their latest period.

The gigantic *Aranea avicularia*, or Bird-Catching Spider, is too remarkable an insect to be passed over in silence. This enormous spider is not uncommon in many parts of the East Indies and South America; where it resides among trees, frequently seizing on small birds, which it destroys by wounding with its fangs, and afterwards sucking their blood: the slit or orifice near the tip of the fangs in spiders, through which the poisonous fluid is evacuated, and the existence of which has sometimes afforded so much matter of doubt among naturalists, is in this species so visible, that it may be distinctly perceived without the assistance of a glass.

This animal appears to admit of some varieties, differing both in size and colour; or rather, it is probable that several species, really distinct, have been often confounded in the works of naturalists under one common title.

During the early part of the last century, a project was entertained by a French gentleman, Monsier Bon, of Montpelier, of insti-

tuting a manufacture of spider's silk; and the Royal Academy, to which the scheme was proposed, appointed the ingenious Reaumur to repeat the experiments of Monsieur Bon, in order to ascertain how far the proposed plan might be carried; but, after making the proper trials, Mr. Reaumur found it to be impracticable, on account of the natural disposition of these animals, which is such as will by no means admit of their living peaceably together in large numbers. Mr. Reaumur also computed that 663,522 spiders would scarcely furnish a single pound of silk. Monsieur Bon however, the first projector, carried his experiments so far as to obtain two or three pair of stockings and gloves of this silk, which were of an elegant grey colour, and were presented, as samples, to the Royal Academy. It must be observed, that in this manufacture it is the silk of the egg-bags alone that can be used, being far stronger than that of the webs. Monsieur Bon collected twelve or thirteen ounces of these, and having caused them to be well cleared of dust, by properly beating with sticks, he washed them perfectly clean in warm water. After this they were laid to steep, in a large vessel, with soap, salt-petre, and gum arabic. The whole was left to boil over a gentle fire for three hours, and were afterwards again washed to get out the soap; then laid to dry for some days, after which they were carded, but with much smaller cards than ordinary. The silk is easily spun into a fine and strong thread: the difficulty being only to collect the silk-bags in sufficient quantity.

Monsieur Reaumur, among his objections, states, that the thread, notwithstanding Mr. Bon's description, is far inferior to that of the silkworm, both in lustre and strength: the thread of the spider's web, according to this author, bears a weight of only twelve grains without breaking; whereas that of the silkworm bears the weight of thirty-six.

The egg-bags used for the purpose were, probably, those of the aranea diadema, and others nearly allied to it.

We have before observed, that these insects are but ill calculated for living in society. Whenever thus stationed, they never fail to wage war with each other. The females in particular are of a disposition peculiarly capricious and malignant; and it is observed that if the male happens to pay his courtship at an unfavourable moment, the female suddenly springs upon him and destroys him.

On this occasion, says Linnæus, if ever, may be justly applied the Ovidian line.

Res est solliciti plena timoris amor!

There remains one more particularity in the history of spiders with which we shall conclude the description of the genus, viz. the power of flight. This is chiefly exercised by those of less advanced age, and seems possessed but in an inferior degree by those which are full grown. It is principally in the autumnal season that these diminutive adventurers ascend the air, and contribute to fill it with that infinity of floating cobwebs which are so peculiarly conspicuous at that period of the year. When inclined to make these aërial excursions, the spider ascends some slight eminence, as the top of a wall, or the branch of a tree, and, turning itself with its head towards the wind ejaculates* (according to Dr. Lister) several threads; and, rising from its situation, commits itself to the gale, and is thus carried far beyond the height of the loftiest towers, and enjoys the pleasure of a clearer atmosphere. During their flight, it is probable that spiders employ themselves in catching such minute winged insects as may happen to occur in their progress; and when satisfied with their journey and their prey, they suffer themselves to fall, by contracting their limbs, and gradually disengaging themselves from the thread which supported them. This curious particular in the history of spiders was first observed by Dr. Hulse, about the year 1668, and was soon confirmed by Dr. Lister and Mr. Ray. Dr. Lister made several very accurate observations on this subject, and even ascended some of the highest edifices on purpose to observe it, and saw spiders sailing as far as the eye could reach above these, till at length they vanished from his view.

[*Ray. Lister. Shaw. Phil. Trans.*

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* The ejaculation or darting of the threads is doubted by Swammerdam and some others, who rather suppose that the threads are driven by the wind from the papillæ of the animal.

SECTION XVI.

White Ant.

Termes pulsatorius. Termes bellicosus.—LINN.

Of the termes, or white ant genus, there are ten species, of which some are much smaller, and others larger. The most common to our own country, and indeed to Europe at large, is the termes pulsatorius of Linnæus, a diminutive insect, of a whitish colour; and which, from its general resemblance to the insects of that genus, has by Derham and some other naturalists been distinguished by the title of pediculus pulsatorius. It is very frequent, during the summer months, in houses, particularly where the wainscot is in any degree decayed, and is remarkable for causing a long-continued sound, exactly resembling the ticking of a watch. It is a very common insect in collections of dried plants, &c. which it often injures greatly. It is of so tender a frame as to be easily destroyed by the slightest pressure; and is an animal of very quick motion. When magnified, the head appears large; the eyes remarkably conspicuous, of a most beautiful gold-colour, and divided, like those of most other insects, into innumerable hexagonal convexities; the antennæ long and setaceous; the palpi or feelers two in number, of moderate length, and terminating in a large club-shaped tip; the thorax rather narrow, and the abdomen obtusely oval; the thighs or first joints of the legs thick, the remaining ones slender, and the feet furnished with very small claws: the whole animal is beset with small scattered hairs. According to the observations of the celebrated Derham, this insect, at its first hatching from the egg, which is white, oval, and extremely small, bears a complete resemblance to a common mite, being furnished with eight legs, and beset with long hairs. After a certain time, it casts its skin, and appears in the very different form above-described. Some individuals of this species become winged when arrived at their full growth; the wings, which are four in number, being very large, of a slightly iridescent appearance, and variegated with blackish and brown clouds or spots. It is in the beginning of July that this change takes place,

and at this time several may be seen with the wings half-grown; in a few days they seem to obtain their full size.

Mr. Derham imagines the ticking sound which these animals produce, to be analogous to the call of birds to their mates during the breeding season; and there seems to be no reason for calling in question the truth of this observation. We may add, that this sound, as well as that produced by the ptinus fatidicus, or death-watch, seems to afford a convincing proof of the faculty of hearing in insects, which some naturalists have been inclined to deny.

Of the exotic termites, the most remarkable seems to be the termes bellicosus, whose history is described by Mr. Smeathman in the Philosophical Transactions.

With the good order of their subterraneous cities, they will appear foremost on the list of the wonders of the creation, as most closely imitating mankind in provident industry and regular government.

The termites are represented by Linnæus as the greatest plagues of both Indies, and are indeed every way between the tropics so deemed. These insects have generally obtained the names of ants, it may be presumed, from the similarity in their manner of living; which is in large communities that erect very extraordinary nests, for the most part on the surface of the ground, whence their excursions are made through subterraneous passages, or covered galleries, which they build whenever necessity obliges, or plunder induces, them to march above ground; and at a great distance from their habitations carry on a business of depredation and destruction, scarcely credible but to those who have seen it.

The termites resemble the ants also in their provident and diligent labour, but surpass them as well as the bees, wasps, beavers, and all other animals, in the arts of building, as much as the Europeans excel the least cultivated savages. It is more than probable they excel them as much in sagacity, and the arts of government; it is certain, they shew more substantial instances of their ingenuity and industry than any other animals; and do in fact lay up vast magazines of provisions and other stores; a degree of prudence which has of late years been denied, perhaps without reason, to the ants.

Their communities consist of one male and one female (who are

generally the common parents of the whole, or greater part, of the rest); and of three orders of insects, apparently of very different species, but really the same, which together compose great commonwealths, or rather monarchies, if we may be allowed the term.

The different species of this genus resemble each other in form, in their manner of living, and in their good and bad qualities; but differ as much as birds, in the manner of building their habitations or nests, and in the choice of the materials of which they compose them.

There are some species which build upon the surface of the ground, or part above and part beneath; and one or two species, perhaps more, that build on the stems or branches of trees, sometimes aloft at a vast height.

Of every species there are three orders; first, the working insects, which, for brevity, we shall generally call labourers; next the fighting ones, or soldiers, which do no kind of labour; and, last of all, the winged ones, or perfect insects, which are male and female, and capable of propagating.

The nests of the termes bellicosus are so numerous all over the island of Bananas, and the adjacent continent of Africa, that it is scarcely possible to stand upon any open place, such as a rice-plantation, or other clear spot, where one of these buildings is not to be seen within fifty paces, and frequently two or three are to be seen almost close to each other. In some parts near Senegal, as mentioned by Monsieur Adanson, their number, magnitude, and closeness of situation, make them appear like the villages of the natives.

These buildings are usually termed hills, by natives as well as strangers, from their outward appearance, which is that of little hills more or less conical, generally pretty much in the form of sugar-loaves, and about ten or twelve feet in perpendicular height above the common surface of the ground.

These hills continue quite bare until they are six or eight feet high; but in time the dead barren clay, of which they are composed, becomes fertilized by the genial power of the elements in these prolific climates, and the addition of vegetable and other matters brought by the wind; and in the second or third year the hillock, if not over-shaded by trees, becomes, like the rest of

the earth, almost covered with grass and other plants; and in the dry season, when the herbage is burnt up by the rays of the sun, it is not much unlike a very large hay-cock.

Every one of these buildings consists of two distinct parts, the exterior and the interior. The exterior is one large shell in the manner of a dome, large and strong enough to inclose and shelter the interior from the vicissitudes of the weather, and the inhabitants from the attacks of natural or accidental enemies. It is always, therefore, much stronger than the interior building, which is the habitable part, divided with a wonderful kind of regularity and contrivance, into an amazing number of apartments for the residence of the king and queen, and the nursing of their numerous progeny; or for magazines, which are always found well filled with stores and provisions.

From these habitations, galleries again ascend, and lead out horizontally on every side, and are carried under ground near to the surface a vast distance; for if you destroy all the nests within one hundred yards of your house, the inhabitants of those which are left unmolested farther off, will nevertheless carry on their subterraneous galleries, and invade the goods and merchandizes contained in it by sap and mine, and do great mischief if you are not very circumspect.

It has been observed, that there are of every species of termites three orders; of these orders, the working insects or labourers are always the most numerous; in the termes bellicosus there seems to be, at the least, one hundred labourers to one of the fighting insects or soldiers. They are in this state about one-fourth of an inch long, and twenty-five of them weigh about a grain; so that they are not so large as some of our ants. The second order, or soldiers, have a very different form from the labourers, and have been by some authors supposed to be the males, and the former neuters; but they are, in fact, the same insects, only they have undergone a change of form, and approached one degree nearer to the perfect state. They are now much larger, being half an inch long, and equal in bulk to fifteen of the labourers. There is now likewise a most remarkable circumstance in the form of the head and mouth; for in the former state, the mouth is evidently calculated for gnawing and holding bodies; but in this state, the jaws being shaped just like two very sharp awls, a little jagged, they

are incapable of any thing but piercing or wounding; for which purposes they are very effectual, being as hard as a crab's claw, and placed in a strong horny head, which is of a nut-brown colour, and larger than all the rest of the body together, which seems to labour under great difficulty in carrying it; on which account perhaps the animal is incapable of climbing up perpendicular surfaces. The third order, or the insect in its perfect state, varies its form still more than ever. The head, thorax, and abdomen, differ almost entirely from the same parts in the labourers and soldiers; and, besides this, the animal is now furnished with four fine, large, brownish, transparent wings, with which it is at the time of emigration to wing its way in search of a new settlement. We may open twenty nests without finding one winged insect, for those are to be found only just before the commencement of the rainy season, when they undergo the last change, which is preparative to their colonization.

In the winged state, they have also much altered their size as well as form. Their bodies now measure between six and seven tenths of an inch in length, and their wings above two inches and a half from tip to tip, and they are equal in bulk to about thirty labourers, or two soldiers. They are now also furnished with two large eyes, placed on each side of the head, and very conspicuous: if they have any before, they are not easily to be distinguished. Probably in the two first states, their eyes, if they have any, may be small, like those of moles; for as they live, like these animals, always under ground, they have as little occasion for these organs, and it is not to be wondered at that we do not discover them; but the case is much altered when they arrive at the winged state, in which they are to roam, though but for a few hours, through the wide air, and explore new and distant regions. In this form the animal comes abroad during, or soon after, the first tornado, which, at the latter end of the dry season, proclaims the approach of the ensuing rains; and seldom waits for a second, or third shower, if the first, as is generally the case, happens in the night, and brings much wet after it.

The quantities that are to be found the next morning all over the surface of the earth, but particularly on the waters, are astonishing; for their wings are only calculated to carry them a few hours, and after the rising of the sun not one in a thousand is to

be found with four wings, unless the morning continues rainy, when here and there a solitary being is seen winging its way from one place to another, as if solicitous only to avoid its numerous enemies; particularly various species of ants which are hunting on every spray, on every leaf, and in every possible place, for this unhappy race, of which probably not a pair in many millions get into a place of safety, fulfil the first law of nature, and lay the foundation of a new community.

The termites arborum, those which build in trees, frequently establish their nests within the roofs and other parts of houses, to which they do considerable damage, if not timely extirpated. The large species are not only much the most destructive, but more difficult to be guarded against; since they make their approaches chiefly under ground, descending below the foundations of houses and stores, at several feet from the surface, and rising again either in the floors, or entering at the bottoms of the posts, of which the sides of the buildings are composed, bore quite through them, following the course of the fibres to the top, or making lateral perforations and cavities here and there as they proceed.

While some are employed in gutting the posts, others ascend from them, entering a rafter, or some other part of the roof. If they once find the thatch, which seems to be a favourite food, they soon bring up wet clay, and build their pipes or galleries through the roof in various directions, as long as it will support them: sometimes eating the palm-tree leaves and branches of which it is composed; and, perhaps (for variety seems very pleasing to them) the rattan, or other running plant, which is used as a cord to tie the various parts of the roof together, and that to the posts which support it; thus, with the assistance of the rats, who during the rainy season are apt to shelter themselves there, and to burrow through it, they very soon ruin the house, by weakening the fastenings, and exposing it to the wet. in the mean time the posts will be perforated in every direction, as full of holes as that timber in the bottoms of ships which has been bored by the worms; the fibres and knotty parts, which are the hardest, being left to the last.

They sometimes, in carrying on this business, seem to find that the post has some weight to support; and then, if it is a conve-

nient track to the roof, or is itself a kind of wood agreeable to them, they bring their mortar, and fill all or most of the cavities, leaving the necessary roads through it, and as fast as they take away the wood, replace the vacancy with that material; which being worked together by them closer and more compactly than human strength or art could ram it, when the house is pulled to pieces, in order to examine if any of the posts are fit to be used again, those of the softer kinds are often reduced almost to a shell, and all, or a greater part, transformed from wood to clay, as solid and as hard as many kinds of free-stone used for building in England. It is much the same when the termites bellicosi get into a chest or trunk, containing clothes and other things; if the weight above is great, or they are afraid of ants or other enemies, and have time, they carry their pipes through, and replace a great part with clay, running their galleries in various directions. The tree termites, indeed, when they get within a box, often make a nest there, and being once in possession, destroy it at their leisure.

When the termites attack trees and branches in the open air, they sometimes vary their manner of doing it. If a stake in a hedge has not taken root and vegetated, it becomes their business to destroy it. If it has a good sound bark round it, they will enter at the bottom, and eat all but the bark, which will remain, and exhibit the appearance of a solid stick (which some vagrant colony of ants or other insects often shelter in, till the winds disperse it); but if they cannot trust the bark, they cover the whole stick with their mortar, and then it looks as if it had been dipped into thick mud that had been dried on. Under this covering they work, leaving no more of the stick and bark than is barely sufficient to support it, and frequently not the smallest particle; so that upon a very small tap with your walking-stick, the whole stake, though apparently as thick as your arm, and five or six feet long, loses its form, and, disappearing like a shadow, falls in small fragments at your feet.

The first object of admiration which strikes one upon opening their hills, is the behaviour of the soldiers. If you make a breach in a slight part of the building, and do it quickly with a strong hoe, or pick-axe, in the space of a few seconds a soldier will run out, and walk about the breach, as if to see whether the enemy is

gone, or to examine what is the cause of the attack. He will sometimes go in again, as if to give the alarm; but most frequently, in a short time, is followed by a large body, who rush out as fast as the breach will permit them; and so they proceed, the number increasing, as long as any one continues battering their building. It is not easy to describe the rage and fury they shew. In their hurry they frequently miss their hold, and tumble down the sides of the hill, but recover themselves as quickly as possible; and, being blind, bite every thing they run against, and thus make a crackling noise; while some of them beat repeatedly with their forceps, upon the building, and make a small vibrating noise, something shriller and quicker than the ticking of a watch. If they get hold of any one, they will in an instant let out blood enough to weigh against their whole body; and if it is the leg they wound, you will see the stain upon the stocking extend an inch in width. They make their hooked jaws meet at the first stroke, and never quit their hold, but suffer themselves to be pulled away leg by leg, and piece after piece, without the least attempt to escape. On the other hand, keep out of their way, and give them no interruption, and they will in less than half an hour retire into the nest, as if they supposed the wonderful monster that damaged their castle to be gone beyond their reach. Before they are all got in, you will see the labourers in motion, and hastening in various directions toward the breach, every one with a burthen of mortar in his mouth, ready-tempered. This they stick upon the breach as fast as they come up, and do it with so much dispatch and facility, that although there are thousands, or rather millions, of them, they never stop or embarrass one another; and you are most agreeably deceived, when, after an apparent scene of hurry and confusion, a regular wall arises, gradually filling up the chasm. While they are thus employed, almost all the soldiers are retired quite out of sight.

A renewal of the attack, however, instantly changes the scene. At every stroke we hear a loud hiss; and on the first the labourers run into the many pipes and galleries with which the building is perforated, which they do so quickly that they seem to vanish, for in a few seconds all are gone, and the soldiers rush out as numerous and as vindictive as before.

Previously to breeding, a very surprising change takes place in

the body of the queen or breeding animal. The abdomen of this female, in the termes bellicosus especially, begins gradually to extend and enlarge to such an enormous size, that an old queen will have it increased so as to be fifteen hundred, or two thousand times the bulk of the rest of her body; and twenty or thirty thousand times the bulk of a labourer. Mr. Smeethman conjectures the animal is upwards of two years old, when the abdomen is increased to three inches in length; and has sometimes found them of near twice that size. The abdomen is now of an irregular oblong shape, being contracted by the muscles of every segment, and is become one vast matrix full of eggs, which make long circumvolutions through an innumerable quantity of very minute vessels, that circulate round the inside in a serpentine manner, which would exercise the ingenuity of a skilful anatomist to dissect and develop. This singular matrix is not more remarkable for its amazing extension and size, than for its peristalic motion, which resembles the undulating of waves, and continues incessantly without any apparent effort of the animal; so that one part or other alternately is rising and sinking in perpetual succession, and the matrix seems never at rest, but is always protruding eggs to the amount of sixty in a minute; or eighty thousand and upward in one day of twenty-four hours. These eggs are instantly taken from her body by her attendants (of whom there are always, in the royal chamber, and the galleries adjacent, a sufficient number in waiting) and carried to the nurseries, which in a great nest may some of them be four or five feet distant in a straight line, and consequently much farther by their winding galleries. Here, after they are hatched, the young are attended and provided with every thing necessary, until they are able to shift for themselves, and take their share of labour.

[*Derham. Phil. Trans. Gregory.*

SECTION XVII.

Crab. Lobster.

Cancer.—Linn.

The voluminous genus of the cançer comprises upwards of eighty distinct species, of which the common lobster and land-crab are peculiarly worthy of notice.

1. *Common Lobster.*

Cancer gammarus.—Linn.

This species inhabits the common rocky shores of our island, but chiefly where there is a depth of water. In Llyn, in Caernarvonshire, a certain small lobster, nothing different, except in size, burrows in the sand. Lobsters fear thunder, and are apt to cast their claws on a great clap: it is said they will do the same on the firing of a great gun; and that, when men of war meet a lobster-boat, a jocular threat is used, that if the master does not sell them good lobsters, they will salute him. This species inhabits the clearest water, at the foot of rocks that impend over the sea; which has given opportunity of examining more closely into the natural history of the animal, than of many others who live in an element, that in a great measure limits the inquiries of the most inquisitive. Some lobsters are taken by hand; but the greater quantity in pots, a sort of trap formed with twigs, and baited with garbage. They are formed like a wire mouse-trap, so that when the lobster gets in, it cannot return. Lobsters begin to breed in spring, and continue breeding most part of the summer. Dr. Bagster says he counted 12,444 eggs under the tail, besides those that remained in the body unprotruded. They deposit those eggs in the sand, where they are soon hatched. Lobsters change their shells annually. They acquire an entire new coat in a few days; but during the time that they remain defenceless, they seek some very lonely place, for fear of being devoured by such of their brethren as are not in the same situation. It is remarkable, that lobsters and crabs renew their claws, when accidentally torn off; and they grow again in a few weeks, though they never attain to

the size of the first. They are very voracious animals, and feed on sea-weeds, garbage, and all sorts of dead bodies. Though the ova are cast at all seasons, they seem only to come to life in July and August. Great numbers of them may then be found in the form of tadpoles, swimming about the little pools left by the tides among the rocks; and many also under their proper form, from half an inch to four inches in length. In casting their shells, it is hard to conceive how the lobsters are able to draw the flesh of their large claws out, leaving the shells entire, and attached to the shell of their body, in which state they are constantly found. The fishermen say, the lobster pines before casting, till the flesh of its large claw is no thicker than the quill of a goose, which enables it to draw its parts through the joints and narrow passage near the trunk. The new shell is quite membranaceous at first, but hardens by degrees. Lobsters only grow in size while their shells are in their soft state. They are chosen for the table, by their being heavy in proportion to their size; and by the hardness of the shells on their sides, which, when in perfection, will not yield to moderate pressure.

2. *Land-Crab.*

Cancer ruricola.—LINN.

THE crabs of this species inhabit the Bahama islands, as well as most lands between the tropics. These animals live not only in a kind of orderly society, in the retreats in the mountains; but regularly, once a year, march down to the sea-side in a body of some millions at a time. As they multiply in great numbers, they choose the month of April or May to begin their expedition; and then sally out by thousands from the stumps of hollow trees, from the clefts of rocks, and from the holes which they dig for themselves under the surface of the earth. At that time the whole ground is covered with this band of adventurers; there is no setting down one's foot without treading upon them. The sea is their place of destination, and to that they direct their march with right-lined precision. No geometrician could send them to their destined station by a shorter course; they neither turn to the right nor left, whatever obstacles intervene; and even if they meet with

a house, they will attempt to scale the walls to keep the unbroken tenor of their way. But though this is the general order of their route, they, upon other occasions, are obliged to conform to the face of the country; and if it is intersected with rivers, they are then seen to wind along the course of the stream. They are often obliged to halt for want of rain, and go into the most convenient encampment till the weather changes. The main body of the army is composed of females, which never leave the mountains till the rain is set in for some time. The night is their chief time of proceeding; but if it rains by day, they do not fail to profit by the occasion; and they continue to move forward in their slow uniform manner. When the sun shines, and is hot, upon the surface of the ground, they make a universal halt, and wait till the cool of the evening. When they are terrified, they march back in a confused disorderly manner, holding up their nippers, with which they sometimes tear-off a piece of the skin, and then leave the weapon where they inflicted the wound. They even try to intimidate their enemies; for they often clatter their nippers together, as if to threaten those that disturb them. But though they thus strive to be formidable to man, they are much more so to each other; for they are possessed of one most unsocial property, which is, that if any of them by accident be maimed, in such a manner as to be incapable of proceeding, the rest fall upon and devour it on the spot, and then pursue their journey. When, after a fatiguing march, and escaping a thousand dangers, (for they are sometimes three months in getting to the shore,) they have arrived at the destined port, they prepare to cast their spawn, which shaking off into the water, they leave accident to bring it to maturity. At this time, shoals of hungry fish are at the shore in expectation of this annual supply; the sea to a great distance seems black with them; and about two-thirds of the crab's eggs are immediately devoured by these rapacious invaders. The eggs that escape are hatched under the sand; and, soon after, millions at a time of these little crabs are seen quitting the shore, and slowly travelling up to the mountains. This animal, when possessed of its retreats in the mountains, is impregnable: for, only subsisting on vegetables, it seldom ventures out: and its habitation being in the most inaccessible places, it remains for a great part of the season in perfect security. It is only when impelled by the desire of bringing forth

its young, and when compelled to descend into the flat country, that it is taken. At that time, the natives wait for its descent in eager expectation, and destroy thousands; but, disregarding their bodies, they only seek for that small spawn which lies on each side of the stomach, within the shell, of about the thickness of a man's thumb. They are much more valuable upon their return after they have cast their shell; for, being covered with a skin resembling soft parchment, almost every part except the stomach may be eaten. They are taken in the holes by feeling for them with an instrument; they are sought after by night, when on their journey, by flambeaux. The instant the animal perceives itself attacked, it throws itself on its back, and with its claws pinches most terribly whatever it happens to fasten on. But the dextrous crab-catcher takes them by the hinder legs, in such a manner that the nippers cannot touch him, and thus he throws them into his bag. Sometimes also they are caught when they take refuge in the bottoms of holes in rocks by the sea-side, by covering the mouth of the hole, to prevent their getting out; and then, soon after, the tide coming, enters the hole, and the animal is found, upon its ebbing, drowned in its retreat. These crabs are of various sizes, the largest about six inches wide; they walk side-ways like the sea-crab, and are shaped like them: some are black, some yellow, some red, and others variegated with red, white, and yellow, mixed.

The light-coloured are reckoned best; and when in full flesh, are very well tasted.

[*Phil. Trans. Fabricius. Gregory.*

CHAP. IV.

FISHES.

Pisces.—Linn.

SECTION I.

Eel.

Muræna anguilla.—Linn.

The eel is a very singular fish in several things that relate to its natural history, and in some respects borders on the nature of the reptile tribe.

It is known to quit its element; and, during night, to wander along the meadows, not only for change of habitation, but also for the sake of prey, feeding on the snails it finds in its passage.

During winter it beds itself deep in the mud, and continues in a state of rest like the serpent kind. It is very impatient of cold, and will eagerly take shelter in a whisp of straw, flung into a pond in severe weather, which has sometimes been practised as a method of taking them. Albertus goes so far as to say, that he has known eels to shelter in a hay-rick, yet all perish through excess of cold.

It has been observed, that in the river Nyne there is a variety of small eel, with a lesser head and narrower mouth than the common kind; that it is found in clusters in the bottom of the river, and is called the bed-eel; these are sometimes roused up by violent floods, and are never found at that time with meat in their stomachs. This bears such an analogy with the clustering of blind-worms, in their quiescent state, that we cannot but consider it as a further proof of a partial agreement in the nature of the two genera.

The ancients adopted a most wild opinion about the generation of these fish, believing them to be either created from the mud, or

that the scrapings of their bodies, which they left on the stones, were animated and became young eels. Some moderns gave into these opinions, and into others that were equally extravagant. They could not account for the appearance of these fish in ponds that never were stocked with them, and that were even so remote as to make their being met with in such a place a phenomenon that they could not solve. But there is much reason to believe, that many waters are supplied with these fish by the aquatic fowl of prey, in the same manner as vegetation is spread by many of the land-birds, either by being dropped as they carry them to feed their young, or by passing quick through their bodies, as is the case with herons; and such may be the occasion of the appearance of these fish in places where they were never seen before. As to their immediate generation, it has been sufficiently proved to be effected in the ordinary course of nature, and that they are viviparous.

They are extremely voracious, and very destructive to the fry of fish.

No fish lives so long out of water as the eel; it is extremely tenacious of life, as its parts will move a considerable time after they are flayed and cut into pieces.

The eel is placed by Linnæus in the genus of *murænu*, his first of the apodal fish, or such which want the ventral fins.

The eyes are placed not remote from the end of the nose: the irides are tinged with red: the under jaw is longer than the upper: the teeth are small, sharp, and numerous: beneath each eye is a minute orifice; at the end of the nose two others, small and tubular.

The fish is furnished with a pair of pectoral fins, rounded at their ends. Another narrow fin on the back, uniting with that of the tail: and the anal fin joins it in the same manner beneath.

Behind the pectoral fins is the orifice to the gills, which are concealed in the skin.

Eels vary much in their colours, from a sooty hue to a light olive green; and those which are called silver eels have their bellies white, and a remarkable clearness throughout.

Besides these, there is another variety of this fish, known in the Thames by the name of grigs, and about Oxford by that of grigs or gluts. These are scarce ever seen near Oxford in the

winter, but appear in spring, and bite readily at the hook, which common eels in that neighbourhood will not. They have a larger head, a blunter nose, thicker skin, and less fat than the common sort; neither are they so much esteemed, nor do they often exceed three or four pounds in weight.

Common eels grow to a large size, sometimes so great as to weigh fifteen or twenty pounds, but that is extremely rare. As to instances brought by Dale and others, of these fish increasing to a superior magnitude, we have much reason to suspect them to have been congers, since the enormous fish they describe have all been taken at the mouths of the Thames or Medway.

The eel is the most universal of fish, yet it is scarce ever found in the Danube, though it is very common in the lakes and rivers of Upper Austria.

The Romans held this fish very cheap, probably from its likeness to a snake.

> Vos anguilla manet longæ cognata colubræ,
> Vernula riparam pinguis torrente cloaca.
>
> JUVENAL, Sat. v.

> For you is kept a sink-fed snake-like eel.

On the contrary, the luxurious Sybarites were so fond of these fish, as to exempt from every kind of tribute the persons who sold them.

[*Pennant.*

SECTION II.

Sword-Fish.

Xiphias Gladius.—LINN.

THIS is a native of the Mediterranean, and is mostly found in the Sicilian sea; grows to a very large size, sometimes measuring twenty feet in length; and is of an active and predacious disposition, feeding on the smaller kind of fishes, which it kills by piercing with its sword-shaped snout. The body is long, round, and gradually tapers towards the tail: the head flattish, the mouth

wide, both jaws ending in a point, but the upper stretched to a great distance beyond the lower: this part, which is commonly called the sword, is flattish above and beneath, and sharp on the sides: it is of a bony substance, covered by a strong skin or epidermis: down the middle of the upper part runs an impressed line or furrow, and three similar ones on the lower surface: the tongue is free, or unconnected with the palate, and is of a strong texture, and in the throat are certain rough bones: the nostrils are double, and seated near the eyes, which are moderately large and protuberant: the body is covered by a thin skin, having a thick fatty membrane lying beneath: the lateral line is placed near the back, and is formed of a series of longish black specks: the dorsal fin is very high at its commencement, and sinking suddenly, becomes very shallow, and is continued to within a small distance from the tail, terminating in an elevated process: the vent-fin is placed nearly opposite this part beneath, and is moderately small, and much wider at each extremity than at its middle: the pectoral fins are rather small, and of a lanceolate shape: the tail is large and crescent-shaped; and on each side the body, immediately before the tail, is a strong finny prominence or appendage. The general colour of the sword-fish is brown, accompanied by a deep steel-blue cast on the head and upper parts, and silvery white on the sides and abdomen.

Mr. Pennant observes, that the ancient method of taking the sword-fish, particularly described by Strabo, agrees exactly with that practised by the moderns at the present day. A man ascends one of the cliffs that overhang the sea, and as soon as he spies the fish gives notice, either by his voice or by signs, of the course it takes. Another person, stationed in a boat, climbs up the mast, and, on seeing the fish, directs the rowers to it. As soon as he thinks they are got within reach, he descends, and taking a spear in his hand, strikes it into the fish; which, after wearying itself with its agitations, is seized and drawn into the boat. It is much esteemed by the Sicilians, who cut it in pieces and salt it: this process was anciently performed, particularly at the town of Thurii, in the bay of Tarentum; and hence the fish was called Tomus Thurianus *.

* Plin. l. 32, c. 11.

The sword-fish is occasionally found not only in the Mediterranean but in the Northern seas, and sometimes in the Pacific: it is probable, however, that it has been often confounded with a different species more common in that ocean.

This fish is bold and active, and in one instance was known to attack an East Indiaman, which he would certainly have sunk, by driving his long serrated snout or sword through its hulk, but that he killed himself by the violence of his attack; in consequence of which the sword remained in the timbers of the ship, and no leak of any consequence ensued. A piece of the hulk, with a part of the fish's sword imbedded in it, was presented to the British Museum, and may still be seen there as an object of curiosity.

[*Pennant. Shaw. Editor.*

SECTION III.

Electrical Eel, or Gymnote.

Gymnotus electricus.—Linn.

Electrical Torpedo, or Ray.

Raia torpedo.—Linn.

There are various fishes which have a power of collecting and discharging small portions of the electric fluid; some a quantity so minute as to be scarcely sensible, like that thrown forth from the hair of the cats' back, to the hand that touches it: but others in a quantity so considerable, as to produce exhaustion and numbness of the nerves exposed to its action, or even a shock equal to that of a large Leyden phial.

Of this last kind the two most celebrated are those which we have enumerated at the head of the section; and which, though in the artificial system of Linnæus, belonging to different orders, we shall here contemplate simultaneously.

The Torpedo has been celebrated both by ancients and moderns for its wonderful faculty of causing a sudden numbness, or painful sensation, in the limbs of those who touch or handle it. This power the ancients, unacquainted with the theory of electricity,

Engraved by Hay from a Drawing by Craig

For the Gallery of Nature & Art

THE TORPEDO.

were contented to admire, without attempting to explain; and, as is usual in similar cases, magnified it into an effect little short of what is commonly ascribed to enchantment. Thus we are told by Oppian, that the torpedo, conscious of his latent faculty, when caught by a hook, exerts it in such a manner, that passing along the line and rod, it benumbs the astonished fisherman, and suddenly reduces him to a state of helpless stupefaction.

"Ναι μεν κι ναρκη," &c.

The hook'd torpedo, with instinctive force,
Calls all his magic from its secret source;
Quick thro' the slender line and polish'd wand
It darts; and tingles in th' offending hand*.
The palsied fisherman, in dumb surprise,
Feels thro' his frame the chilling vapours rise:
Drops the lost rod, and seems, in stiffening pain,
Some frost-fix'd wanderer on the polar plain.

It is affirmed by Pliny, that the torpedo, even when touched with a spear, or stick, can benumb the strongest arm, and stop the swiftest foot.

It is well observed, by Dr. Bloch, that these exaggerations on the part of the ancients are the less to be wondered at, when we reflect on similar ones in modern times. Thus, when Muschenbroek happened accidentally to discover and feel the effect of the electric shock, from what is called the Leyden phial, he represented it of so terrible a nature as to affect his health for several days afterwards; and declared that he would not undergo a second for the whole kingdom of France. Yet this is now the common amusement of philosophical curiosity.

The observations of the learned Redi and others, in the seventeenth century, had tended, in some degree, to elucidate the peculiar actions and anatomy of the torpedo; but it was reserved for more modern times, and for our own ingenious countrymen in particular, to explain, in a more satisfactory manner, the particulars of its history; and to prove that its power is truly electric.

* There are not wanting some who insist that this is no exaggeration, and that the electricity of the torpedo is really conducted in this manner.

The first experiments of this kind were made by Mr. Walsh, of the Royal Society of London, at Rochelle, in France, in the year 1772.

"The effect of the torpedo," says Mr. Walsh, "appears to be absolutely electrical, forming its circuit through the same conductors with electricity, and being intercepted by the same non-conductors, as glass and sealing-wax. The back and the breast of the animal appear to be in different states of electricity; I mean, in particular, the upper and lower surfaces of the two assemblages of pliant cylinders engraved in the work of Lorenzini *. By the knowledge of this circumstance, we have been able to direct his shocks, though they were small, through a circuit of four persons, all feeling them; and likewise through a considerable length of wire held by two insulated persons, one touching his lower surface, and the other his upper. When the wire was exchanged for glass or sealing-wax, no effect could be obtained: but as soon as it was resumed, the two persons became liable to the shock. These experiments have been varied many ways, and repeated, times without number, and they all determined the choice of conductors to be the same in the torpedo as in the Leyden phial. The sensations, likewise, occasioned by the one and the other, in the human frame, are precisely similar. Not only the shock, but the numbing sensation, which the animal sometimes dispenses, expressed in French by the words *engourdissement* and *fourmillement*, may be exactly imitated with the phial, by means of Lane's electrometer: the regulating rod of which, to produce the latter effect, must be brought almost into contact with the prime conductor which joins the phial. It is a singularity that the torpedo, when insulated, should be able to give us, insulated likewise, forty or fifty successive shocks, from nearly the same part; and these, with little, if any, diminution of their force. Each effort of the animal, to give the shock, is conveniently accompanied by a depression of the eyes, by which even his attempts to give it to non-conductors can be observed: in respect to the rest of his body, he is in a great degree motionless, though not entirely so. I have taken no less than fifty of the above mentioned successive shocks, from an insulated torpedo, in the space of a minute and a half.

* Observazioni intorno alle torpedini. 1768.

All our experiments confirm, that the electricity of the torpedo is condensed, in the instant of its explosion, by a sudden energy of the animal; and as there is no gradual accumulation, or retention of it, as in the case of charged glass, it is not at all surprising, that no signs of attraction or repulsion were perceived in the pith balls. In short, the effect of the torpedo appears to arise from a compressed elastic fluid, restoring itself to its equilibrium in the same way, and by the same mediums as the elastic fluid compressed in charged glass. The skin of the animal, bad conductor as it is, seems to be a better conductor of his electricity than the thinnest plate of elastic air. Notwithstanding the weak spring of the torpedinal electricity, I was able, in the public exhibitions of my experiments at La Rochelle, to convey it through a circuit, formed from one surface of the animal to the other, by two long brass wires, and four persons, which number, at times, was encreased even to eight. The several persons were made to communicate with each other, and the two outermost with the wires, by means of water, contained in basins, properly disposed between them for that purpose."

This curious and convincing experiment is thus related by Monsieur Seignette, (mayor of La Rochelle, and one of the secretaries of its academy) published in the French gazettes for the month of October, in the above year.

"A live torpedo was placed on a table. Round another table stood five persons insulated. Two brass wires, each thirteen feet long, were suspended to the ceiling by silken strings. One of these wires rested by one end on the wet napkin on which the fish lay: the other end was immersed in a basin full of water, placed on the second table, on which stood four other basins likewise full of water. The first person put a finger of one hand in the basin in which the wire was immersed, and a finger of the other hand in a second basin. The second person put a finger of one hand in this last basin, and a finger of the other hand in the third; and so on successively, till the five persons communicated with one another by the water in the basins. In the last basin one end of the second wire was immersed; and with the other end Mr. Walsh touched the back of the torpedo, when the five persons felt a commotion, which differed in nothing from that of the Leyden

experiment, except in the degree of force. Mr. Walsh, who was not in the circle of conduction, received no shock. This experiment was repeated several times, even with eight persons, and always with the same success. The action of the torpedo is communicated by the same mediums as that of the electric fluid. The bodies which intercept the action of the one, intercept likewise the action of the other. The effects produced by the torpedo resemble in every respect a weak electricity. This exhibition of the electric powers of the torpedo, before the academy of La Rochelle, was at a meeting, held for the purpose, in my apartments, on the twenty-second of July, 1772, and stands registered in the journals of the Academy."

Mr. Walsh, in his paper on this subject, in the Philosophical Transactions, thus continues the account of these interesting experiments. "The effect of the animal, in the above experiments, was transmitted through as great an extent and variety of conductors as almost at any time we had been able to obtain it; and the experiments included nearly all the points in which its analogy with the Leyden phial had been observed. These points were stated to the gentlemen present; as were the circumstances in which the two effects appeared to vary. It was likewise represented to them, that our experiments had been almost wholly with the animal in air: that its action in water was a capital desideratum: that indeed all as yet done was little more than opening the door to inquiry: that much remained to be examined by the electrician as well as the anatomist: that, as artificial electricity had thrown light on the natural operation of the torpedo, this might in return, if well considered, throw light on artificial electricity; particularly in those respects in which they now seemed to differ. The torpedo, in these experiments, dispensed only the distinct, instantaneous stroke, so well known by the name of the electric shock. That protracted but lighter sensation, that torpor or numbness which he at times induces, and from which he takes his name, was not then experienced from the animal; but it was imitated with artificial electricity, and shewn to be producible by a quick consecution of minute shocks. This, in the torpedo, may perhaps be effected by the successive discharge of his numerous cylinders, in the nature of a running fire of musketry: the strong

single shock may be his general volley. In the continued effect, as well as in the instantaneous, his eyes, which are usually prominent, are withdrawn into their sockets.

" A large torpedo, very liberal of his shocks, being held with both hands, by his electric organs, above and below, was briskly plunged into water to the depth of a foot, and instantly raised an equal height in air; and was thus continually plunged and raised, as quick as possible, for the space of a minute. In the instant his lower surface touched the water, in his descent, he always gave a violent shock; and another, still more violent, in his ascent; both which shocks, but particularly the last, were accompanied with a writhing in his body, as if meant to force an escape. Besides these two shocks from the surface of the water, which may yet be considered as delivered in the air, he constantly gave at least two when wholly in the air; and as constantly one, and sometimes two, when wholly in the water. The shocks in water appeared, as far as sensation could decide, not to have near a fourth of the force of those which took place at the surface of the water, nor much more than a fourth of those entirely in air.

" The shocks received in a certain time were not, on this occasion, counted by a watch, as they had been on a former, when fifty were delivered in a minute and a-half, by the animal in an insulated and unagitated state: but from the quickness with which the immersions were made, it may be presumed there were full twenty of these in a minute; from whence the number of shocks in that time must have amounted to above a hundred. This experiment, therefore, while it discovered the comparative force between a shock in water, and one in air; and between a shock delivered with greater exertion on the part of the animal, and one with less, seemed to determine, that the charge of his organs with electricity was effected in an instant, as well as the discharge.

" The torpedo was then put into a flat basket, open at the top, but secured by a net with wide meshes, and in this confinement was let down into the water, about a foot below the surface: being there touched through the meshes, with only a single finger, on one of his electric organs, while the other hand was held at a distance in the water, he gave shocks which were distinctly felt in both hands.

" The circuit for the passage of the effect being contracted to

the finger and thumb of one hand, applied above and below to a single organ, produced a shock, to our sensation, of twice the force of that in the larger circuit by the arms.

"The torpedo, still confined in the basket, being raised to within three inches of the surface of the water, was there touched with a short iron bolt, which was held half above and half in the water, by one hand, while the other hand was dipped, as before, at a distance in the water; and strong shocks, felt in both hands, were thus obtained through the iron.

"A wet hempen cord being fastened to the iron bolt, was held in the hand above water, while the bolt touched the torpedo, and the shocks were obtained through both these substances.

"A less powerful torpedo, suspended in a small net, being frequently dipped into water and raised again, gave, from the surface of the water, slight shocks, through the net, to the person holding it.

"These experiments in water manifested, that bodies, immersed in that element, might be affected by immediate contact with the torpedo; that the shorter the circuit in which the electricity moved, the greater would be the effect; and that the shock was communicable, from the animal in water, to persons in air, through some substances.

"How far harpoons and nets, consisting of wood and hemp, could, in like circumstances, as it has been frequently asserted, convey the effect, was not so particularly tried as to enable us to confirm it. I mention the omission in hope that some one may be induced to determine the point by express trial.

"We convinced ourselves, on former occasions, that the accurate Kæmpfer, who so well describes the effect of the torpedo, and happily compares it with lightning, was deceived in the circumstance, that it could be avoided by holding in the breath; which we found no more to prevent the shock of the torpedo, when he was disposed to give it, than it would prevent the shock of the Leyden phial.

"Several persons, forming as many distinct circuits, can be affected by one stroke of the animal, as well as when joined in a single circuit. For instance, four persons, touching separately his upper and lower surfaces, were all affected; two persons, likewise, after the electricity had passed through a wire into a basin

of water, transmitted it from thence, in two distinct channels, as their sensation convinced them, into another basin of water, from whence it was conducted, probably in an united state, by a single wire. How much further the effect might be thus divided and subdivided into different channels, was not determined; but it was found to be proportionately weakened by multiplying these circuits, as it had been by extending the single circuit."

The body of the torpedo is of a somewhat circular form, perfectly smooth, slightly convex above, and marked along each side of the spine by several small pores or foramina: the colour of the upper surface is usually a pale reddish brown, sometimes marked by five large, equidistant, circular dusky spots, with paler centres: the under surface is whitish or flesh-coloured. The torpedo, however, is observed to vary considerably in the cast and intensity of its colours. The general length of the torpedo seems to be about eighteen inches, or two feet, but it is occasionally found of far larger dimensions, specimens having been taken on our own coasts of the weight of fifty, sixty, and even eighty pounds. A specimen weighing fifty-three pounds was found, according to Mr. Pennant, to measure four feet in length, and two and a-half in breadth: the head and body, which were indistinct, were nearly round; about two inches thick in the middle, attenuating to extreme thinness on the edges: below the body the ventral fins formed on each side a quarter of a circle: the two dorsal fins were placed on the trunk of the tail: the eyes were small, placed near each other: behind each was a round spiracle, with six small cutaneous rays on their inner circumference: the mouth was small; the teeth minute and spicular: the colour of the animal was cinereous brown above, and white beneath. The torpedo is an inhabitant of most seas, but seems to arrive at a larger size in the Mediterranean than elsewhere. It is generally taken with the trawl, but has been sometimes known to take a bait, thus justifying the description of Oppian. It commonly lies in water of about forty fathoms depth, in company with others of this genus. It preys on smaller fish; and, according to Mr. Pennant, a surmullet and a plaise have been found in the stomach of two of them: the surmullet, as Mr. Pennant well observes, is a fish of that swiftness, that it would be impossible for the torpedo to take it by pursuit: we must therefore suppose that it stupifies its prey by

exerting its electric faculty. The torpedo often inhabits sandy places, burying itself superficially, by flinging the sand over it, by a quick flapping of all the extremities. It is in this situation that it gives its most forcible shock, which is said to throw down the astonished passenger that inadvertently treads on the animal.

The torpedo, with respect to its general anatomy, does not materially differ from the rest of the ray tribe, except in its electric organs; which have been accurately described by Mr. Hunter, as placed on each side of the cranium and gills, reaching from thence to the semicircular of each great fin, extending to a considerable distance longitudinally, and within these limits occupying the whole space between the skin of the upper and of the under surface. From whence it appears, that the electric organs of the torpedo constitute a pair of galvanic batteries, disposed in the form of perpendicular hexagonal columns. In the gymnotus electricus, on the contrary, the galvanic battery is disposed lengthwise on the lower part of the animal.

We are informed by the ingenious Dr. Ingenhouz, that on taking up some torpedos, about twenty miles from Leghorn, he observed that on pressing gently with the thumbs on the upper side of the two soft bodies on each side of the head (the electric organs), in about the space of a minute or two, he felt a sudden trembling in the thumbs, which extended no farther than the hands, and lasted about two seconds, perfectly resembling the sensation produced by a great number of very small electrical bottles, discharged in quick succession through the hand. After some seconds the sensation returned, and again at more distant intervals. Sometimes it was so strong as almost to oblige the hand to let go the fish; and at other times was but weak; and after the fish had given one strong shock, it did not seem to lose the power of communicating one of similar strength; and it was sometimes found, that when the shocks followed one another in quick succession, the last were stronger than the first.

The celebrated Spallanzani informs us, that some few minutes before the torpedo expires, the shocks which it communicates, instead of being given at distant intervals, take place in quick succession, like the pulsations of the heart: they are weak indeed, but perfectly perceptible to the hand when laid on the fish at this juncture, and resemble very small electric shocks. In the space

of seven minutes, no less than three hundred and sixty of these small shocks were perceived. Spallanzani also assures us of another highly curious fact, which he had occasion to verify from his own experience, viz. that the young torpedo can not only exercise its electric faculty as soon as born, but even while it is yet a fœtus in the body of the parent animal. This was ascertained by Spallanzani on dissecting a torpedo in a pregnant state, and which contained in its ovarium several roundish eggs of different sizes, and also two perfectly formed fœtuses, which, when tried in the usual manner, communicated a very sensible electric shock, and which was still more perceptible when the little animals were insulated by being placed on a plate of glass.

The electricity of the torpedo is altogether voluntary, and sometimes, if the animal be not irritated, it may be touched, or even handled without being provoked to exert its electric influence.

The peculiar species of electricity, or galvanism, exerted at pleasure by the GYMNOTE greatly surpasses that of the torpedo, and has been an extensive subject of admiration both in ancient and modern times. The electric gymnotus is a native of the warmer regions of Africa and America, where it inhabits the larger rivers, and is particularly found in those of Surinam. In Africa it is said chiefly to occur in the branches of the river Senegal. It is a fish of a disagreeable appearance; bearing a general resemblance to a large eel, though somewhat thicker in proportion, and of a much darker colour, being commonly of an uniform blackish brown. It is usually seen in the length of three or four feet, but is said to arrive at a far larger size; specimens occasionally occurring of six, seven, or even ten feet in length. It was first made known to the philosophers of Europe about the year 1671, when its wonderful properties were announced to the French academy by Monsr. Richer, one of the gentlemen sent out by the academy to conduct some mathematical observations in Cayenne. This account however seems to have been received with a degree of cautious scepticism by the major part of European naturalists, and it was not till towards the middle of the late century that a full and general conviction appears to have taken place; the observations of Monsr. Condamine, Mr. Ingram, Mr. Gravesend, and others, then conspiring to prove that the power of this animal consists in a specie

of real electricity, being conducted by similar conducting substances, and intercepted by others of an opposite nature. Thus, on touching the fish with the fingers, the same sensation is perceived as on touching a charged phial, being sometimes felt as far as the elbows; and if touched by both hands, an electric shock is conveyed through the breast in the usual manner. Fermin, in particular, who, during his residence in Surinam, had frequent opportunities of examining the animal, demonstrated by experiment that fourteen slaves, holding each other by the hands, received the shock at the same instant; the first touching the fish with a stick *, and the last dipping his hand into the water in which it was kept. The experiments of Dr. Bancroft were equally satisfactory. After this, viz. about the year 1773, Mr. Williamson, in a letter from Philadelphia to Mr. Walsh, so celebrated for his observations relative to the electricity of the torpedo, communicated his own highly satisfactory experiments on the gymnotus. On touching the animal with one hand, in such a manner as to irritate it considerably, while the other was held at a small distance from it in the water, he experienced as strong a shock as from a charged Leyden phial. The shock was also readily communicated through a circle formed by eight or ten persons at once; the person at one extremity putting his hand in the water, near the fish, while the other touched the animal. It would be tedious to recite all the various modifications of these experiments, and it is sufficient to add, that all conspired to prove the genuine voluntary electricity of the animal; though occasionally exhibiting some variations from the phænomena of common electricity. It is by this extraordinary faculty that the gymnotus supports its existence: the smaller fishes and other animals which happen to approach it, being instantly stupified, and thus falling an easy prey to the electrical tyrant. So powerful is the shock which this fish, in its native waters, is capable of exerting, that it is said to deprive almost entirely of sense and motion those who are exposed to its approach, and is therefore much dreaded by those who bathe in the rivers it inhabits.

A very accurate description of the exterior form of the gymnote was drawn up by the late ingenious Dr. Garden, of Charles Town, in South Carolina, addressed to the celebrated Mr. Ellis; and an

* Probably a green or moist one.

equally accurate description of its internal structure, and more particularly of its electric or galvanic organs, is given by Mr. Hunter. Both these are printed in the 65th volume of the Philosophical Transactions.

"The largest of these fishes," says Dr. Garden, "was three feet eight inches in length, when extending itself most, and might have been from ten to fourteen inches in circumference about the thickest part of the body. The head is large, broad, flat, smooth, and impressed here and there with holes, as if perforated with a blunt needle, especially towards the sides, where they are more regularly ranged in a line on each side. The rostrum is obtuse and rounded. The upper and lower jaws are of an equal length, and the gape is large. The nostrils are two on each side; the first large and tubular, and elevated above the surface; the others small, and level with the skin, placed immediately behind the verge of the rostrum, at the distance of an inch asunder. The eyes are small, flattish, and of a blueish colour, placed about three quarters of an inch behind the nostrils, and more towards the sides of the head. The whole head seems to be well supported; but whether with bones or cartilages I could not learn. The body is large, thick, and roundish, for a considerable distance from the head, and then gradually grows smaller, but at the same time deeper; or becomes of an acinaciform shape, to the point of the tail, which is rather blunt. There are many light-coloured spots on the back and sides of the body, placed at considerable distances in regular lines, but more numerous and distinct towards the tail. When the fish was swimming, it measured six inches in depth near the middle, from the upper part of the back to the lower edge of the fin, and it could not be more than two inches broad on the back at that place. The whole body, from about four inches below the head, seems to be clearly distinguished into four different longitudinal parts or divisions. The upper part or back is roundish, of a dark colour, and separated from the other parts on each side by the lateral sine which, taking their rise at the base of the head, just above the pectoral fins, run down the sides, gradually converging, as the fish grows smaller, to the tail, and make so visible a depression or furrow in their course, as to distinguish this from the second part or division, which may be properly called the body, or at least, appears to be the strong muscular part of the fish. This second divi-

sion is of a lighter and more clear blueish colour than the upper or back part, and seems to swell out somewhat on each side, from the depression of the lateral lines; but towards the lower or under part, is again contracted, or sharpened into the third part or carina. This carina or keel is very distinguishable from the other two divisions by its thinness, its apparent laxness, and by the reticulated skin of a more grey or light colour, with which it is covered. When the animal swims gently in pretty deep water, the rhomboidal reticulations of the skin of this carina are very discernible; but when the water is shallow, or the depth of the carina is contracted, these reticulations appear like many irregular longitudinal plicæ. The carina begins about six or seven inches below the base of the head, and gradually widening or deepening as it goes along, reaches down to the tail, where it is thinnest. It seems to be of a strong muscular nature. Where it first takes its rise from the body of the fish, it seems to be about one inch, or one inch and a half thick, and is gradually sharpened to a thin edge, where the fourth or last is situated; viz. a long, deep, soft, wavy fin, which takes its rise about three or four inches at most below the head, runs down along the sharp edge of the carina to the extremity of the tail. When it first rises it is not deep, but gradually deepens or widens as it approaches the tail. It is of a very pliable soft consistence, and seems rather longer than the body. The situation of the vent of this fish is very singular, being placed underneath, and being about an inch more forward than the pectoral fins, and consequently considerably nearer the rostrum. There are two pectoral (if I may call them so) fins, placed one on each side, just behind the head, over the foramina spiratoria, which are small, and generally covered with a lax skin, situated in the axillæ of these fins. These fins are small for the size of the fish, being scarcely an inch in length, and of a very thin, delicate consistence, and orbicular shape. They seem to be chiefly useful in supporting and raising the head of the fish when he wants to breathe, which he does every four or five minutes, by raising his mouth out of the water. This shews that he has lungs and is amphibious, and the foramina spiratoria seem to indicate his having branchiæ likewise*; but this I only offer as a conjecture, not being certain of the fact. I must

* This idea has since been proved erroneous; the gymnote is not strictly amphibious, any more than the eel.

now mention the appearances of a number of small cross bands, annular divisions, or rather rugæ of the skin of the body. They reach across the body down to the base of the carina on each side; those that cross the back seem to terminate at the lateral lines, where new rings take their rise, not exactly in the same line, and run down to the carina. This gives the fish somewhat of a worm-like appearance; and indeed it seems to have some of the properties of this tribe, for it has a power of lengthening or shortening its body to a certain degree, for its own conveniency, or agreeably to its own inclination. I have seen this specimen, which I have measured three feet eight inches, shorten himself to three feet two inches; but besides this power of lengthening or shortening his body, he can swim forwards or backwards with apparently equal ease to himself, which is another property of the vermicular tribe. When he swims forwards, the undulations or wavy motions of the fin and carina begin from the upper part, and move downwards; but when he swims backwards, and the tail goes foremost, the undulations of the fin begin at the extremity of the tail or fin, and proceed in succession from that backwards to the upper part of the body: in either case he swims equally swift. Every now and then the fish lays himself on one side, as it were, to rest himself, and then the four divisions of the body above mentioned are very distinctly seen, viz. the vermiform appearance of the two upper divisions; the retiform appearance of the carina, and the last or dark-coloured fin, whose rays seem to be exceedingly soft and flexible, and entirely at the command of the strong muscular carina. When he is taken out of the water and laid on his belly, the carina and fin lie on one side, in the same manner as the ventral fin of the tetraodon does, when he creeps on the ground. I have been the longer and more particular in the description of the external structure of this animal's body, because I think, as it is of a most singular nature, and endowed with some amazing properties, even the most minute circumstance I was able to observe relating to it should be mentioned. The power it has of giving an electrical shock to any person, or to any number of persons who join hands together, the extreme person on each side touching the fish, is its most singular and astonishing property. The five we have here are possessed of this power in a very great degree, and communicate the shock to one person, or to any number of persons, either by

the immediate touch of the fish with the hand, or by the intervention of any metalline rod. The keeper says that when first caught, they could give a much stronger shock by a metalline conductor than they can do at present. The person who is to receive the shock must take the fish with both hands, at some considerable distance asunder, so as to form the communication, otherwise he will not receive it; at least I never saw any one shocked from taking hold of it with one hand only: though some have assured me that they were shocked by laying one hand on him. I myself have taken hold of the largest with one hand often, without ever receiving a shock; but I never touched it with both hands, at a little distance asunder, without feeling a smart shock. I have often remarked, that when it is taken hold of with one hand, and the other hand is put into the water over its body, without touching it, the person received a smart shock; and I have observed the same effect follow, when a number joined hands, and the person at one extremity of the circle took hold of or touched the fish, and the person at the other extremity put his hand into the water, over the body of the fish. The shock was communicated to the whole circle as smartly as if both the extreme persons had touched the fish. In this it seems to differ widely from the torpedo, or else we are much misinformed of the manner in which the benumbing effect of that fish is communicated. The shock which our Surinam fish gives seems to be wholly electrical; and all the phænomena or properties of it exactly resemble those of the electric aura of our atmosphere when collected, as far as they are discoverable from the several experiments made on this fish. This stroke is communicated by the same conductors, and intercepted by the interposition of the same original electrics, or electrics per se, as they are called. The keeper of these fish informed me that he caught them in Surinam river, a great way up, beyond where the salt water reaches; and that they are a fresh-water fish only. He says that they are eaten, and by some people esteemed a great delicacy. They live on fish, worms, and any animal food, if it is cut small, so that they can swallow it. When small live fishes are thrown into the water, they first give them a shock, which kills, or so stupifies them, that they can swallow them easily and without any trouble. If one of these small fishes, after it is shocked, and to all appearance dead, be taken out of the vessel where the electrical fish is, and put into fresh water,

it will soon revive again. If a larger fish than they can swallow be thrown into the water, at a time that they are hungry, they give him some smart shocks, till he is apparently dead, and then endeavour to swallow or suck him in; but, after several attempts, finding he is too large, they quit him. Upon the most careful inspection of such fish, I could never see any mark of teeth, or the least wound or scratch upon them. When the electrical fish are hungry, they are pretty keen after their food; but they are soon satisfied, not being able to contain much at a time. An electrical fish of three feet and upwards in length cannot swallow a small fish above three or at most three inches and a half long. I am told that the electrical fish is sometimes found in the river Surinam upwards of twenty feet in length, and that the stroke or shock proves instant death to the person who receives it."

Mr. Hunter's accurate description of the electric or galvanic organs of this curious animal, is as follows:

"This fish, on the first view, appears very much like an eel, from which resemblance it has most probably got its name; but it has none of the specific properties of that fish. This animal may be considered, both anatomically and physiologically, as divided into two parts, viz. the common animal part, and a part which is superadded, viz. the peculiar organ. I shall at present consider it only with respect to the last; as the first explains nothing relating to the other, nor any thing relating to the animal economy of fish in general. The first, or common animal part, is so contrived as to exceed what was necessary for itself, in order to give situation, nourishment, and most probably the peculiar property to the second. The last part, or peculiar organ, has an immediate connexion with the first; the body affording it a situation, the heart nourishment, and the brain nerves, and probably its peculiar powers. For the first of these purposes the body is extended out in length, being much longer than would be sufficient for what may be called its progressive motion. For the real body, or that part where the viscera lie, is situated, with respect to the head, as in other fish, and is extremely short; so that, according to the ordinary proportions, this should be a very short fish. Its great length, therefore, seems chiefly intended to afford a surface for the support of the peculiar organ: the tail part, however, is likewise adapted to the progressive motion of the whole, and to preserve

the specific gravity; for the spine, medulla spinalis, muscles, fin, and air-bladder, are continued through its whole length. Besides which part, there is a membrane passing from the spine to that fin which runs along the belly or lower edge of the animal. This membrane is broad at the end next to the head, terminating in a point at the tail. It is a support for the abdominal fin, gives a greater surface of support for the organ, and makes a partition between the organs of the two opposite sides."

[*Bloch. Shaw. J. Hunter.*

SECTION IV.

Cod-fish.

Radus morhua.—Linn.

This highly important and prolific species, which furnishes employment for so many thousands, and forms so considerable a part of the subsistence of mankind, is an inhabitant of the northern seas, where it resides in immense shoals, performing many migrations at stated seasons, and visiting in succession the different coasts of Europe and America. Its history is so well detailed by Mr. Pennant, that little can be added to what that author has collected in his British and Arctic Zoology.

"The general rendezvous of the cod-fish," says Mr. Pennant, "is on the banks of Newfoundland, and the other sand-banks that lie off the coasts of Cape Breton, Nova Scotia, and New England. They prefer those situations on account of the quantity of worms produced in those sandy bottoms, which tempts them to resort there for food; but another cause of this particular attachment to those spots is their vicinity to the polar seas, where they return to spawn: there they deposit their roe in full security, but want of food forces them, as soon as the first more southern seas are open, to repair thither for subsistence. Few are taken north of Iceland, but on the south and west coasts they abound: they are again found to swarm on the coasts of Norway, in the Baltic, off Orkney and the Western Isles; after which their numbers decrease, in proportion as they advance towards the south, when they seem quite to cease before they reach the mouth of the Straits of Gibraltar."

Before the discovery of Newfoundland, the greater fisheries of cod were on the seas of Iceland and our own Western Isles, which were the grand resort of the ships of all the commercial nations, but it seems that the greatest plenty was met with near Iceland.

Newfoundland, a name in the infancy of discovery common to all North America, was discovered in the year 1496, by the celebrated Venetians, Sebastian Cobat and his three sons: who, at their own charges, under a grant of Henry the Seventh, giving them possession, as vassals of his, of all the lands they might discover, coasted from lat. 57. 30, to the Capes of Florida.

The isle of Newfoundland is of a triangular form, and lies between lat. 46. 40, and 51. 30: visited occasionally, but not inhabited, by savages from the continent. The boasted mine of this island, viz. its sand-bank, is represented as a vast submarine mountain, of above 500 miles long, and 300 broad, and seamen know when they approach it, by the great swell of the sea, and the thick mists that impend over it. The water on the bank is from twenty-two to fifty fathoms; on the outside from sixty to eighty; and on the smaller banks much the same. The number of ships that resort to these fertile banks is now unspeakable: our own country still enjoys the greatest share, and they ought to be esteemed one of our chief treasures, bringing wealth to individuals, and strength to the state. All this immense fishery is carried on by the hook and line only: the principal baits are herring, the small fish called a capelin, the shell-fish called clams, and pieces of sea-fowl; and with these are caught fish sufficient to find employ for fifteen thousand British seamen, and to afford subsistence to a much more numerous body of people at home, who are engaged in the various manufactures which so vast a fishery demands. The fish, when taken, are properly cleaned, salted, and dried, and in this state sent into various parts of the European continent.

The cod grows to a very large size. Mr. Pennant commemorates a specimen taken on the British coasts which weighed seventy-eight pounds, and measured five feet eight inches in length, and five feet in girth round the shoulders; but the general size, at least in the British seas, is far less, and the weight from about fourteen to forty pounds; and such as are of middling size are most esteemed for the table.

The cod is of a moderately long shape, with the abdomen very

thick and prominent; the head is of moderate size, and the eyes large; the jaws of equal length, the lower one bearded at the tip by a single cirrus; in the jaws and palate are numerous sharp teeth; the dorsal and anal fins are rather large, the pectoral rather small; the ventral small and slender; the tail of moderate size, and even at the end, the first ray on each side being short, strong, and bony. The usual colour of this fish is cinereous on the back and sides, and commonly spotted with dull yellow; the belly white or silvery; but the colours occasionally vary very considerably, and instances are often seen in which a yellow, orange, or even red tint prevails on the upper parts of the body, while the spots are lighter or deeper according to the different seasons in which the fish is taken; the lateral line, which is one of the principal distinctive marks of the species, is broad and whitish, and the scales are somewhat larger than in the other genus.

The food of the cod is either small fish, worms, testaceous or crustaceous animals, such as crabs, large whelks, &c. its digestion is so powerful as to dissolve the greatest part of the shells it swallows: it is very voracious, catching at any small body it perceives moved by the water, even stones and pebbles, which are often found in the stomach. The fishermen are well acquainted with the use of the air bladder or *sound* of this fish, and dexterously perforate the living fish with a needle, in order to let out the air contained in that part; for without this operation the fish could not be kept under water in the well-boats, and brought fresh to market. The sounds when salted, are reckoned a delicacy, and are often brought in this state from Newfoundland. A species of isinglass is also prepared from this part of the fish by the natives of Iceland.

[*Shaw. Pennant.*

SECTION V.

Mackrel.

Scomber scomber.—Linn.

This beautiful fish is a native of the European and American seas; generally appearing at stated seasons, and swarming, in vast shoals, round particular coasts. Its great resort however seems to be within the Arctic circle, where it resides in innumerable troops,

grows to a larger size than elsewhere, and is supposed to find its favourite food, consisting chiefly of marine insects, in far greater plenty than in warmer latitudes. During the severity of the northern winter, it is said to lie imbedded in the soft mud, beneath the vast crusts of ice surrounding the polar coasts; being thus sufficiently protected from the effects of frost; and, on the return of spring, is generally believed to migrate in enormous shoals, of many miles in length and breadth, and to visit the coasts of more temperate climates in order to deposit its spawn. Its route has been supposed nearly similar to that of the herring; passing between Iceland and Norway, and proceeding towards the northern part of our own island, where a part throws itself off into the Baltic, while the grand column passes downwards, and enters the Mediterranean through the straits of Gibraltar.

This long migration of the mackrel, as well as of the herring, seems at present to be greatly called in question: and it is thought more probable that the shoals which appear in such abundance round the more temperate European coasts, in reality reside during the winter at no very great distance; immersing themselves in the soft bottom, and remaining in a state of torpidity *; from which they are awakened by the warmth of the returning spring, and gradually recover their former activity. At their first appearance their eyes are observed to appear remarkably dim, as if covered with a kind of film, which passes off as the season advances, when they appear in their full perfection of colour and vigour.

The general length of the mackrel is from twelve to fifteen or sixteen inches; but in the northern seas it is occasionally found of far greater size, and among those which visit our own coasts instances sometimes occur of specimens far exceeding the general size of the rest. The colour of this fish, on the upper parts, as far as the lateral line, is a rich deep blue, accompanied by a varying tinge of green, and marked by numerous black transverse streaks, which in the male are nearly straight, but in the female beautifully undulated; the jaws, gill-covers, and abdomen, are of a bright

* Of this the Count de Cepede adduces the testimony of an eye-witness; viz. Mons. Pleville-le-Pelcy, who, about the coasts of Hudson's Bay, observed the mud, at the bottom of the small clear hollows encrusted with ice round those coasts, entirely bristled over by the tails of mackrels imbedded in it nearly three parts of their length.

silver colour, with a slight varying cast of gold-green along the sides, which are generally marked in the direction of the lateral line by a row of long dusky spots; the scales are very small, oval, and transparent; the pinnules or spurious fins are small, and are five in number both above and below. The shape of the mackrel is highly elegant, and it is justly considered as one of the most beautiful of the European fishes. Its merit as an article of food is universally established, and it is one of those fishes which have maintained their reputation through a long succession of ages; having been highly esteemed by the ancients, who prepared from it the particular condiment or sauce known to the Romans by the title of *garum*, and made by salting the fish, and after a certain period, straining the liquor from it. This preparation, once so famous, has been long superseded by the introduction of the anchovy, for similar purposes.

[*Willoughby. Pennant. Shaw.*

SECTION VI.

Remora, or Sucking-Fish.

Echeneis remora.—LINN.

THE extraordinary faculty which this fish possesses, of adhering at pleasure with the utmost tenacity to any moderately flat surface, was not unobserved by the ancients, and is described in terms of considerable luxuriance by Pliny in particular, who, giving way to the popular prejudices of his time, represents the remora as possessing the power of stopping a vessel in full sail, so as to render it perfectly immoveable in the midst of the sea.

" *Ventum est ad summa naturæ*," *&c.*

Let the reader take the translation in the words of Philemon Holland.

" Having so far proceeded in the discourse of Nature's historie, that I am now arrived at the very height of her forces, and come into a world of examples, I cannot chuse but in the first place consider the power of her operations, and the infininesse of her secrets, which offer themselves before our eyes in the sea: for in no part else of this universal frame is it possible to observe the like majestie of nature: insomuch as we need not seeke any farther, nay we ought not to make more search into her divinitie, considering there

cannot be found any thing equall or like unto this one element, wherein she hath surmounted and gone beyond her own selfe in a wonderful number of respects. For first and foremost, Is there any thing more violent than the sea, and namely when it is troubled with blustring winds, whirlepuffs, storms and tempests? or wherein hath the wit of man been more employed (seeke out all parts of the whole world) than in seconding the waves and billows of the sea, by saile and ore? Finally, is ought more admirable than the inenarrable force of the reciprocall tides of the sea, ebbing and flowing as it doth, whereby it keepeth a current also, as it were the stream of some great river?

"The current of the sea is great, the tide much, the winds vehement and forcible, and more than that, ores and sailes withall to help forward the rest, are mightie and powerfull: and yet this one little sillie fish, named *echeneis*, that checketh, scorneth, and arresteth them all: let the winds blow as much as they will, rage the storms and tempests what they can, yet this little fish commaundeth their furie, restraineth their puissance, and maugre all their force as great as it is, compelleth ships to stand still: a thing which no cables be they never so big and able as they will, can performe. She bridleth the violence and tameth the greatest rage of this universall world, and that without any paine that she putteth herselfe unto, without any holding and putting backe, or any other meane, save only by cleaving and sticking fast to a vessell: in such a sort as this one small and poore fish is sufficient to resist and withstand so great a power both of sea and navie, yea and to stop the passage of a ship, doe they all what they can possible to the contrarie. What should our fleets and armadoes at sea, make such turrets in their decks and forecastles? what should they fortifie their ships in warlike manner, to fight from them upon the sea, as it were from mure and rampier on firme land? See the vanitie of man! alas, how foolish are we to make all this adoe! When one little fish, not above half a foot long, is able to arrest and stay perforce, yea and hold as prisoners our goodly tall and proud ships, so well armed in the beake-head with yron pikes and brazen tines; so offensive and dangerous to bouge and pierce any enemie ship which they doe encountre. Certes, reported it is, that in the naval battaile before Actium, wherein Antonius and Cleopatra the queene were defeited by Augustus, one of these fishes staied the admirall

ship wherein M. Antonius was, at what time as he made all the haste and meanes he could devise with help of ores to encourage his people from ship to ship, and could not prevaile, untill he was forced to abandon the said admirall and goe into another galley. Meanwhile the armada of Augustus Cæsar, seeing this disorder, charged with greater violence, and soone invested the fleete of Antonie. Of late daies also, and within our remembrance, the like happened to the roiall ship of the Emperor Caius Caligula, at what time as he rowed backe, and made saile from Astura to Antium; when and where this little fish detained his ship, and (as it fell out afterward) presaged an unfortunate event thereby: for this was the last time that ever this emperour made his return to Rome; and no sooner was he arrived, but his own souldiours in a mutinie fell upon him and stabbed him to death. And yet it was not long ere the cause of this wonderfull staie of his ship was knowne; for so soon as ever the vessel (and a galliace it was, furnished with five bankes of ores to a side) was perceived alone in the fleete to stand still, presentlie a number of tall fellows leapt out of their ships into the sea, to search what the reason might be that it stirred not? and found one of these fishes sticking fast to the very helme; which being reported unto Caius Caligula, he fumed and fared as an emperour, taking great indignation that so small a thing as it, should hold him back perforce, and check the strength of his mariners, notwithstanding there were no fewer than foure hundred lustie men in his galley that laboured at the ore all that ever they could to the contrarie. But this prince (as it is for certain knowne) was most astonied at this, namely, that the fish sticking only to the ship, should hold it fast; and the same being brought into the ship and there laid, not worke the like effect. They who at that time and afterward saw the fish, report that it resembled for all the world a snaile of the greatest making; but as touching the form and sundrie kinds thereof, many have written diversly, whose opinions I have set downe in my treatise of living creatures belonging to the waters, and namely in the particular discourse of this fish; neither doe I doubt but all the sorte of fishes are able to do as much; for this we are to beleeve, that pourcellans also be of the same vertue, since it was well knowne by a notorious example, that one of them did the like by a ship sent from Periander to the cape of Gnidos: in regard whereof, the inhabitants of Gnidos do honour and conse-

erat the said porcellans within their temples of Venus. Some of our Latin writers do call the said fish that thus staieth a ship, by the name of remora."

The real fact is, that the remora, being a fish of very weak fin, takes the advantage of occasionally attaching itself to any large swimming body, whether animate or inanimate, which it happens to encounter; adhering to ships, as well as whales, sharks, and many other of the larger fishes: is has even been observed by Commerson, that the remora is so ill calculated for supporting a long and laborious course in the water, that when left to its own exertions, it generally swims on its back, and that in an unsteady and feeble manner. It is therefore necessary that it should avail itself of the occasional assistance of some larger floating body. For this purpose the upper part of the head is wonderfully constituted; presenting a large, flat, oval shield or area, traversed by numerous dissepiments or partitions, each of which is fringed at the edge by a row of very numerous perpendicular teeth or filaments, while the whole area or oval space is strengthened by a longitudinal division or septum. So strong is the power of adhesion which the fish by this apparatus is enabled to exert, that we are assured by Commerson, whose observations on this subject are detailed by Cepede, that, on applying his thumb to the shield of a living remora, it was affected not only with a strong stupor, but even with a kind of paralysis, which continued for a considerable time after withdrawing his hand. When attached, as is frequently the case, to the skin of a shark or other large fish, it quits not its hold when the former is drawn out of the water, but continues adhering after the death of the animal; nor is it easy for the strongest arm to effect its separation, unless it be pulled in a lateral direction, so as to force it to slide along the surface of the skin. When a great many of these fishes are thus adhering at once to the sides of a ship, they may in some degree retard its motion, by preventing its easy passage through the water, in the same manner as other extraneous substances are known to do; nor can it be thought improbable that the adhesion of these fishes in considerable numbers to the side of a small canoe in the earlier ages of mankind, may have operated still more powerfully, and not only have impeded its progress, but even have caused it to incline towards one side; and the tale once re-

lated, might have gradually grown into the exaggerated powers afterwards ascribed to the animal.

A second reason of the remora's thus attaching itself to the larger fishes and to vessels is, that it may be in readiness to avail itself of the occasional remains of the prey of the former, or of the offals thrown out of the latter; being naturally voracious, and by no means delicate in its choice, and frequently following vessels in great numbers in order to obtain occasional supplies of food. The remora also, especially in stormy weather, adheres to rocks, like the lump-fish and some others.

The remora is principally an inhabitant of the Mediterranean and Atlantic seas. Its general colour is an uniform brown, without any material difference of shade either on the upper or lower surface. It sometimes however varies in colour, and Commerson assures us, that when a great number of these fishes are attached either to the side of a vessel or to a large fish, it is not very uncommon to see one or two which differ from the rest in being of a whitish colour. The skin is smooth and destitute of scales, but marked with numerous impressed points or pores: the mouth is large, and furnished with very numerous small teeth, and the lower jaw is rather longer than the upper; the eyes are small with yellow irides; the lateral line commences above the pectoral fins, and from thence pretty suddenly descending, runs strait in the tail, which is of a slightly forked, or rather lunated form. The number of transverse divisions on the shield of this species varies from sixteen to twenty, but the most general number is eighteen. The fish grows to the length of about eighteen inches.

[*Shaw. Holland.*

SECTION VII.

Rostrate Chætodon.

Chætodon rostratus.—Linn.

The genus chætodon contains nearly thirty species, mostly natives of the Indian and American seas, being rarely, if ever, taken in those of Europe. It has some resemblance to the flounder tribe; but is distinguished by the great depth and highly com-

pressed form of the body, which in most of the species is beautifully variegated by transverse, oblique, or longitudinal bands, and covered with strong scales finely denticulated on the margins.

The species before us has its snout lengthened into a tubular form, or pipe: it is a native of the fresh waters of India, and is celebrated for the extraordinary manner in which it takes its prey, which chiefly consists of the smaller kind of flying insects: when it observes one of these, either hovering over the water, or seated on some aquatic plant, it shoots against it from its tubular snout a drop of water, with so sure an aim as generally to lay it dead, or at least stupified on the surface. In shooting at a sitting insect, it is commonly observed to approach within the distance of from six to four feet, before it explodes the water. When kept in a state of confinement in a large vessel of water, it is said to afford high entertainment by its dexterity in this exercise, since if a fly or other insect be fastened to the edge of the vessel, the fish immediately perceives it, and continues to shoot at it with such admirable skill as very rarely to miss the mark.

It may not be improper to observe, that this faculty is not entirely confined to the present fish, but takes place in some few others belonging to very different genera.

[*Bloch. Nat. Miscel. Editor.*

SECTION VIII.

Perch.

Perca fluviatilis.—Linn.

The perch of Aristotle and Ausonius is the same with that of the moderns. That mentioned by Oppian, Pliny, and Athenæus, is a sea-fish, probably of the labrus or sparus kind, being enumerated by them among some congenerous species. Our perch was much esteemed by the Romans:

> Nec te delicias mensarum perca, silebo
> Amnigenos inter pisces dignande marinis.
>
> Ausonius.

It is not less admired at present as a firm and delicate fish; and the Dutch are particularly fond of it, when made into a dish called water souchy.

It is a gregarious fish, and loves deep holes and gentle streams. It is a most voracious fish, and eager biter; if the angler meets with a shoal of them, he is sure of taking every one.

It is a common notion that the pike will not attack this fish, being fearful of the spiny fins which the perch erects on the approach of the former. This may be true in respect to large fish; but it is well known the small ones are the most tempting bait that can be laid for the pike.

The perch is a fish very tenacious of life: we have known them carried near sixty miles in dry straw, and yet survive the journey.

These fish seldom grow to a large size: we once heard of one that was taken in the Serpentine River, Hyde Park, that weighed nine pounds; but that is very uncommon.

The body is deep; the scales very rough; the back much arched; side-line near the back.

The irides golden; the teeth small, disposed on the jaws and on the roof of the mouth; the edges of the covers of the gills serrated; on the lower end of the largest is a sharp spine.

The first dorsal fin consists of fourteen strong spiny rays; the second of sixteen soft ones; the pectoral fins are transparent, and consist of fourteen rays; the ventral of six; the anal of eleven.

The tail is a little forked.

The colours are beautiful; the back and part of the sides being of a deep green, marked with five broad black bars pointing downwards; the belly is white, tinged with red; the ventral fins of a rich scarlet; and the anal fins and tail of the same colour, but rather paler.

In a lake called Llyn Raithlyn, in Merionethshire, is a very singular variety of perch; the back is quite hunched, and the lower part of the back-bone next to the tail, strangely distorted; in colour, and in other respects, it resembles the common kind, which are as numerous in the lake as these deformed fish. They are not peculiar to this water; for Linnæus takes notice of a similar variety found at Fahlun, in his own country. I have also heard that it is to be met with in the Thames, near Marlow.

[*Pennant.*

There is one species possessing a very singular power, we mean the perca scanderns, or climbing perch, which is capable, like some

species of the eel, of quitting its native element, and breathing atmospheric air; climbing up posts or props of any kind, to a considerable height, which it effects by means of its peculiarly spinous gills and fins.

[*Editor.*

SECTION IX.

Carp.

Cyprinus carpio.—Linn.

The cyprinus kind includes between thirty and forty known species, of which the chief are the common carp, tench, barbel, gudgeon, bream, roach, dace, chub, and gold-fish.

The carp was introduced into England about the year 1514, by Leonard Maschal, to whom we are also indebted for that excellent apple the pepin. Russia wants these fish at this day. Sweden has them only in the ponds of people of fashion. They chiefly abound in the rivers and lakes of Polish Prussia, where they are sometimes taken of a vast size. They are there a great article of commerce, and sent in well-boats to Sweden and Russia. The merchants purchase them out of the waters of the landholders of the country, who draw a good revenue from this article.

Carp are very long lived. Gesner brings an instance of one that was near 100 years old. They grow also to a very great size. Some authors speak of carp weighing 200 pounds, and five feet in length. The carp is a prodigious breeder; its quantity of roe has been sometimes found so great, that when taken out and weighed against the fish itself, the former has been found to preponderate. From the spawn of this fish, caviare is made for the Jews, who hold the sturgeon in abhorrence. The carp is extremely cunning, and on that account is sometimes stiled the river-fox. They will sometimes leap over the nets, and escape that way; at other times they will immerse themselves so deep in the mud, as to let the net pass over them. They are also very shy in taking a bait; yet at the spawning time they are so simple, as suffer themselves to be tickled, handled, and caught, by any body that will attempt it. This fish is apt to mix its milt with the roe of other fish, from which is produced a spurious breed, as has been observed in the offspring of the carp and tench, which bore the greatest resemblance

to the first. The same has also been observed of the carp and bream.

In Polish Prussia, and many other parts of Germany, the sale of carp constitutes a part of the revenue of the nobility and gentry, so that the proper management of that fish is reduced to a kind of system, founded on the experience of several generations. Of the methods there practised, we have an account in the Philosophical Transactions for 1771, communicated by Mr. J. Reinhold Foster; who says he has seen carp treated and maintained according to those methods, "above a yard long, and of twenty-five pounds weight;" but had no opportunity of ascertaining their age. "In the pond, however, at Charlottenburg," he adds, "a palace belonging to the King of Prussia, I saw more than two or three hundred carp, between two and three feet long; and I was told by the keeper they were between fifty and sixty years standing. They were tame, and came to the shore in order to be fed." Mr. Forster, in this paper, also vouches for a most extraordinary circumstance; namely, the possibility of the carp's not only living for a considerable time out of water, but of its growing fat in its new element. The author has seen the experiment successfully tried, and attended to the whole process, in a nobleman's house, where he then resided, in the principality of Anhalt-Dessau. The fish being taken out of the water, is wrapped up in a large quantity of wet moss, spread on a piece of net, which is then gathered into a purse, in such a manner however as to allow him room to breathe. The net is then plunged into water, and hung up to the cieling of a cellar. At first the dipping must be repeated every three or four hours, but afterwards the carp need only be plunged into the water once in about six or seven hours. Bread soaked in milk is first given him in small quantities. In a short time, the fish will bear more, and grow fat under this seemingly unnatural treatment. Mr. Daines Barrington, in a note, confirms a part of the preceding account, by mentioning the practice of a certain fishmonger near Clare-market, who, in the winter, frequently exposed a bushel, at least, of carp and tench for sale, in the same dry vessel, for six or seven hours, many of which were not sold, and yet continued in health, though breathing nothing but air during the time above-mentioned, for several days successively.

[*Forster. Barrington. Pennant.*

Engraved by Scott from a Drawing by Craig

For the Gallery of Nature & Art

GOLD FISH.

SECTION X.

Gold-Fish *.

Cyprinus auratus.—LINN.

THIS in the artificial system of the Swedish naturalist, is a species, as its generic name imports, of the same kind as the preceding.

It is a small fish domesticated by the Chinese, and generally kept for ornament by great people in their courts and gardens. They breed them in small ponds made for the purpose, in basons, and even in porcelain vessels. This fish is no larger than our pilchard. The male is of a bright red colour, from the top of the head to the middle of the body: the rest is of gold colour; but it is so bright and splendid, that the finest gilding, according to F. le Comte, cannot approach it. The female is white, but its tail and half of its body resemble the lustre of silver. F. du Halde, however, observes, that a red and a white colour are not always the distinguishing marks of the male and female; but that the females are known by several white spots, which are seen round the orifice, that serves them as organs of hearing; and the males, by having these spots much brighter. Gold-fish are light and lively; they love to sport on the surface of the water, soon become familiarized, and may even be accustomed to come and receive their food on sounding a small rattle. Great care is necessary to preserve them; for they are extremely delicate, and sensible of the least injuries of the air; a loud noise, such as that of thunder or cannon; a strong smell, a violent shaking of the vessel or a single touch, will often destroy them. These fish live with little nourishment; those small worms which are engendered in the water, or the earthy particles that are mixed with it, are sufficient for their food. The Chinese, however, take care from time to time, to throw into the basons and reservoirs where they are kept, small balls of paste, which they are very fond of when dissolved; they give them also lean pork, dried in the sun, and reduced to a fine

* The silver fish does not belong to this genus: it is an atherine (*atherina theridia*), a native of the fresh waters of Carolina. EDITOR.

and delicate powder, and sometimes snails : the slime which these insects leave at the bottom of the vessel is a great delicacy to them, and they eagerly hasten to feed on it. In winter they are removed from the court to a warm chamber, where they are kept generally shut up in a porcelain vessel. During that season they receive no nourishment ; however, in spring, when they are carried back to their former bason, they sport and play with the same strength and liveliness as they did the preceding year.

In warm countries these fish multiply fast, provided care is taken to collect their spawn, which floats on the water, and which they almost entirely devour. This spawn is put into a particular vessel, exposed to the sun, and preserved until vivified by the heat. Gold-fish, however, seldom multiply when they are kept in close vases, because they are then too much confined. In order to render them fruitful, they must be put into reservoirs of considerable depth in some places at least, and which are constantly supplied with fresh water. At a certain time of the year, a prodigious number of barks may be seen in the great river Yangtsekiang, which go thither to purchase the spawn of these fish. Towards the month of May, the neighbouring inhabitants shut up the river in several places with mats and hurdles, which occupy an extent of almost nine or ten leagues ; and they leave only a space in the middle sufficient for the passage of barks. The spawn of the fish, which the Chinese can distinguish at first sight, although a stranger could perceive no traces of it in the water, is stopped by these hurdles. The water mixed with spawn is then drawn up, and after it has been put into large vessels, it is sold to merchants, who transport it afterwards to every part of the empire. This water is sold by measure, and purchased by those who are desirous of stocking their ponds and reservoirs with fish.

Notwithstanding the tenderness of these fish even in their native climates, they are now naturalized in Britain, where they even breed. They were first introduced into England about the year 1691 ; but were not generally known till 1728, when a great number were brought over, and presented first to Sir Matthew Dekker, and by him circulated round the neighbourhood of London, whence they have been distributed to most parts of the country.

Nothing can be more amusing than a glass bowl, containing

such fishes: the double refractions of the glass and water represent them, when moving, in a shifting and changeable variety of dimensions, shades, and colours; while the two mediums, assisted by the convex shape of the vessel, magnify and distort them vastly; not to mention that the introduction of another element and its inhabitants into our parlours, engages the fancy in a very agreeable manner.

[*Naturalist's Miscel. Gregory.*

SECTION XI.

Salmon.

Salmo salan.—LINN.

THE salmon, so highly esteemed for the delicacy of its flavour, and so important an article in a commercial view, is chiefly an inhabitant of the northern regions, where it occurs at different periods both in salt and fresh waters; quitting the sea at certain seasons to deposit its spawn in the gravelly beds of rivers, at a great distance from their mouths. In order to arrive at the spots proper for this purpose there are scarce any obstacles which the fish will not surmount. They will ascend rivers* for hundreds of miles; force themselves against the most rapid streams, and spring with amazing agility over cataracts of several feet in height. They are taken, according to Mr. Pennant, in the Rhine as high as Basil: they gain the sources of the Lapland rivers, in spite of their torrent-like currents: they surpass the perpendicular falls of Leixlip†, Kennerth‡, and Pont-Aberglastyn‖. At the latter of these places, Mr. Pennant assures us that he has himself witnessed the efforts of the salmon, and seen scores of fish, some of which succeeded, while others miscarried in the attempt during the time of his observation. It may be added, that the salmon, like the swallow, is said to return each season to the self-same spot to deposit its spawn. This has been ascertained by the experiments of Monsr. de la Lande, who fastening a small ring of copper to the tails of some individuals, and then setting them at liberty, found

* Brit. Zoology.

† Near Dublin.

‡ On the Tivy in S. Wales.

‖ Amid Snowdown hills.

that some of them made their appearance in the same place for three successive seasons*. The experiment of fastening gold or silver rings to salmon is said by Dr. Bloch to have been occasionally practised by some of the Eastern princes; and it is added, that by this method a communication has been proved between the Caspian and Northern seas and the Persian Gulf.

The general history of the salmon fishery on the river Tweed is amply detailed by Mr. Pennant, in the third volume of the British Zoology, chiefly from the communications of Mr. Potts, an inhabitant of the town of Berwick. The principal particulars are as follows.

"At the latter end of the year, or in the month of November, the salmon begin to press up the river as far as they can reach, in order to spawn. When that time approaches, they seek for a place fit for the purpose: the male and female unite in forming a proper receptacle for it in the sand or gravel, about the depth of eighteen inches: in this the female deposits the spawn, which they afterwards cover carefully up by means of their tails, which are observed to have no skin on them for some time after this period. The spawn lies buried till spring, if not disturbed by violent floods, but the salmon hasten to the sea as soon as they are able, in order to recover their strength: for after spawning they are observed to become very lean, and are then called by the name of kippers. When the salmon first enter the rivers, they are observed to have a great many small animals adhering to them, especially about the gills: these are the *Lernææ Salmoneæ* of Linnæus, and are signs that the fish is in high season: soon after the salmon have left the sea, the Lernææ die, and drop off. About the latter end of March, the spawn begins to exclude the young, which gradually increase to the length of four or five inches, and are then called smelts or smouts. About the beginning of May the river is full of them; It seems to be all alive; and there is no having an idea of their numbers without seeing them; but a seasonable flood then hurries them all to the sea, scarce any or very few of them being left in the river. About the middle of June, the earliest of the fry begin to drop as it were into the river again from the sea; at that time about twelve, fourteen, or sixteen inches in length, and by a

* So Monsr. de la Lande was assured by the fishermen.

gradual progress, increase in number and size, till about the end of July, which is at Berwick termed the Gilse time (the name given to the fish at that age). At the end of July, or the beginning of August, they lessen in number, but increase in size, some being six, seven, eight, or nine pounds weight. This appears to be a surprising growth; yet we have received from a gentleman at Warrington an instance still more so. A salmon weighing seven pounds three quarters, taken on the seventh of February, being marked with scissars on the back fin and tail, and turned into the river, was again taken on the seventeenth of the following March, and then found to weigh seventeen pounds and a half *.

" All fishermen agree that they never find any food in the stomach of this fish. Perhaps during the spawning time they may entirely neglect their food, as the Phocæ, called sea-lions and sea-bears, are known to do for months together during the breeding season; and it may be that, like those animals, the salmon return to sea lank and lean, and come from it in good condition. It is evident, that at times their food is both fish and worms, for the angler uses both with good success, as well as a large gaudy artificial fly, which the fish probably mistakes for a gay libellula or dragon-fly. The capture about the Tweed is prodigious: in a good fishery, often a boat load, and sometimes near two, are taken in a tide. Some few years ago there were above seven hundred fish taken at one hawl, but from fifty to a hundred is very frequent: the coopers in Berwick then begin to salt both salmon and gilses in pipes and other large vessels, and afterwards barrel † them to send abroad, having then more than the London markets can take off their hands. Most of the salmon taken before April, or to the setting-in of warm weather, is sent fresh to London in baskets, unless now and then the vessel is disappointed by contrary winds of sailing immediately; in which case the fish is brought ashore again, to the cooper's offices, and boiled, pickled, and kitted, and sent to the London markets by the same ship, and fresh salmon put into the baskets in lieu of the stale ones. At the beginning of the season, when a ship is on the point of sailing,

* According to Dr. Bloch, the growth of the salmon appears to be much slower than here stated. He informs us that a salmon of five or six years old weighs from ten to twelve pounds.

† The salmon barrel holds above forty-two gallons wine measure.

a clean fresh salmon shall sell from a shilling to eighteen-pence a pound; and most of the time that this part of the trade is carried on, the prices are from five to nine shillings per stone*, the value rising and falling according to the plenty of fish, or the prospect of a fair or foul wind †. Some fish are sent in this manner to London the latter end of September, when the weather proves cool, but the fish are then full of large roes, grow very thin-bellied, and are not esteemed either palatable or wholesome. The price of fresh fish, in the month of July, when they are most plentiful, has been known to be as low as 8*d.* per stone.

"The season for fishing in the Tweed begings Nov. the 30th, but the fishermen work very little till after Christmas. It ends on Michaelmas day; yet the corporation of Berwick (who are the conservators of the river) indulge the fishermen with a fortnight past that time, on account of the change of the style.

There are on the river forty-one considerable fisheries, extending upwards, about fourteen miles from the mouth (the others being of no great value), which are rented for near £. 5400 per annum. The expense attending the servants' wages, nets, boats, &c. amounts to £. 5000 more, which together makes up the sum £. 10400. Now in consequence the produce must defray all, and no less than twenty times the sum of fish will effect it, so that 208000 salmon must be caught there, one year with another."

The general length of the salmon is from two and a half to three feet, but sometimes much more ‡: the male is principally distinguished by the curvature of the jaws; both the upper and lower mandible bending towards each other more or less in different individuals, and at different seasons. The general colour of both sexes is a silvery grey, of a much darker cast on the back: the sides of the male are marked with numerous, small, irregular, dusky and copper-coloured spots; while those of the female exhibit

* A stone of salmon weighs 18lb. 20 ounces and a half; or, in other terms, four stones, or forty-six pounds avoirdupoise, is only three stones, or 42lb. fish-weight at Berwick.

† The salmon sent from Berwick to London are, at present, generally packed in ice, which is preserved in ice-houses throughout the winter for that purpose.

‡ It is said to be sometimes found of the length of six feet. Mr. Pennant mentions one of seventy-four pounds weight as the largest he ever heard of.

only several rather large, distant, roundish, or somewhat lunated spots of a dark colour. Exclusive of these differences, the male is of a somewhat longer or more slender shape than the female: the scales in the salmon are middle-sized, and not very strongly adherent.

In the intestinal canal of the salmon is often found a species of tænia or tape-worm, of about three feet in length. Dr. Bloch informs us, that in a salmon which had been three weeks dead, he found one of these worms still living.

[*Bloch. Pennant. Shaw.*

SECTION XII.

Trout.

Salmo fario.—Linn.

The trout is an inhabitant of clear and cold streams and lakes, in most parts of Europe, and admits of considerable variety as to the tinge both of its ground-colour and spots. Its general length is from twelve to fifteen or sixteen inches, and its colour yellowish-grey, darker or browner on the back, and marked on the sides by several rather distant, round, bright, red spots, each surrounded by a tinge of pale blue-grey. Sometimes the ground-colour of the body is a purplish grey; the red spots much larger, more or less mixed with black; and the belly of a white or silvery cast: the fins are of a pale purplish brown; the dorsal fin marked with several darker spots: the head is rather large, the scales small, and the lateral line straight. The female fish is of a brighter and more beautiful appearance than the male.

It is a matter of surprise that this common fish has escaped the notice of all the ancients, except Ausonius: it is also singular, that so delicate a species should be neglected, at a time when the folly of the table was at its height; and that the epicures should overlook a fish that is found in such quantities in the lakes of their neighbourhood, when they ransacked the universe for dainties. The milts of *murœna* were brought from one place; the livers of

scari from another*; and oysters even from so remote a spot as our Sandwich †; but there was and is a fashion in the article of good living. The Romans seem to have despised the trout, the piper, and the doree; and we believe Mr. Quin himself would have resigned the rich paps of a pregnant sow ‡, the heels of camels §, and the tongues of *flamingos* ‖, though dressed by Heliogabalus's cooks, for a good jowl of salmon, with lobster-sauce.

When Ausonius speaks of this fish, he makes no eulogy on its goodness, but celebrates it only for its beauty.

> Purpureisque SALAR stellatus tergore guttis.

> With purple spots the SALAR's back is stain'd.

These marks point out the species he intended: what he meant by his *fario* is not so easy to determine: whether any species of trout, of a size between the *salar* and the salmon; or whether the salmon itself, at a certain age, is not very evident.

> Teque inter geminos species, neutrumque et utrumque,
> Qui nec dum SALMO, nec SALAR ambiguusque
> Amborum medio FARIO intercepte sub ævo.

> SALMON or SALAR, I'll pronounce thee neither:
> A doubtful kind, that may be none, or either.
> FARIO, when stopt in middle growth.

In fact, the colours of the trout, and its spots, vary greatly in different waters, and in different seasons; yet each may be reduced to one species. In Llyndivia, a lake in South Wales, are trouts called *coch y dail*, marked with red and black spots as big as sixpences; others unspotted, and of a reddish hue, that sometimes weigh near ten pounds, but are bad tasted.

In Lough Neagh, in Ireland, are trouts called there *buddaghs*, which not unfrequently weigh thirty pounds; but it was not my fortune to see any during my stay in the neighbourhood of that vast water.

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* Suetonius vita, Vitellii.
† Juvenal, Sat. IV. 141.
‡ Martial, Lib. XIII. Epig. 44.
§ Lampriere vit Heliogab.
‖ Martial, Lib. XI. Epig. 71.

Trouts (probably of the same species) are also taken in Hulse-water, a lake in Cumberland, of a much superior size to those of Lough Neagh. These are supposed to be the same with the trout of the lake of Geneva, a fish many have eaten who think but a very indifferent one.

In the river Eynion, not far from Machyntleth, in Merioneth-shire, and in one of the Snowdon lakes, are found a variety of trout, which are naturally deformed, having a strange crookedness near the tail, resembling that of the perch before described. We dwell the less on these monstrous productions, as the Honourable Daines Barrington, has already given an account of them in an ingenious dissertation on some of the Cambrian fish, published in the Philosophical Transactions of the year 1767.

The stomachs of the common trouts are uncommonly thick and muscular. They feed on the shell-fish of lakes and rivers, as well as on small fish. They likewise take into their stomachs gravel, or small stones, to assist in comminuting the testaceous parts of their food. The trouts of certain lakes in Ireland, such as those of the province of Galway, and some others, are remarkable for the great thickness of their stomachs; which, from some slight resemblance to the organs of digestion in birds, have been called gizzards: the Irish name the species that have them *Gillaroo* trouts. These stomachs are sometimes served up to table, under the former appellation. It does not appear to me, that the extra-ordinary strength of stomach, in the Irish fish, should give any suspicion that it is a distinct species: the nature of the waters might increase the thickness; or the superior quantity of shell-fish, which may more frequently call for the use of its comminuting powers than those of our trout, might occasion this difference. I had opportunity of comparing the stomach of a great *Gillaroo* trout, with a large one from the Uxbridge river. The last, if I recollect, was smaller, and out of season; and its stomach, (not-withstanding it was very thick) was much inferior in strength to that of the former: but, on the whole, there was not the least specific difference between the two subjects.

Trouts are most voracious fish, and afford excellent diversion to the angler; the passion for the sport of angling is so great in the neighbourhood of London, that the liberty of fishing, in some of

the streams in the adjacent counties, is purchased at the rate of ten pounds per annum.

These fish shift their quarters to spawn; and, like salmon, make up towards the heads of rivers to deposit their roes. The under jaw of the trout is subject, at certain times, to the same curvature as that of the salmon.

A trout taken in Llynallet, in Denbighshire, which is famous for an excellent kind, measured seventeen inches, its depth three and three quarters, its weight one pound ten ounces: the head thick; the nose rather sharp; the upper jaw a little longer than the lower; both jaws, as well as the head, were of a pale brown, blotched with black: the teeth sharp and strong; disposed in the jaws, roof of the mouth, and tongue, as is the case with the whole genus, except the gwyniad, which is toothless, and the grayling, which has none on its tongue.

The back was dusky; the sides tinged with a purplish bloom, marked with deep purple spots, mixed with black, above and below the line, which was straight: the belly white.

The dorsal fin was spotted; the spurious fin brown, tipped with red; the pectoral, ventral, and anal fins, of a pale brown; the edges of the anal fin white: the tail very little forked when extended.

[*Shaw. Pennant.*

SECTION XIII.

Flying-Fish.

Exocætus exiliens.—Linn.

The fishes of this genus, which are very few in number, are remarkable for the extreme length and size of their pectoral fins, by which they are enabled to spring occasionally from the water, and to support a kind of temporary flight or continued motion through the air, to the distance of two or three hundred feet; when, the fins becoming dry, they are again obliged to commit themselves to their own element. The species at present to be described is chiefly observed in the Mediterranean and Atlantic seas, where, according to an ingenious naturalist, " it leads a most miserable

life: in its own element it is perpetually harassed by the dorado and other fish of prey; and if it endeavour to avoid them by having recourse to the air, it either meets its fate from the gull and albatross, or is forced down again into the mouth of the inhabitants of the water which keep pace with its aërial excursion." This however ought to be considered as an exaggerated representation of the creature's state of existence, since, by the admirable balance ordained by nature, the weaker animals have powers of escape in exact proportion to their danger.*

It should be observed, that this power of flight or temporary skimming through the air to a considerable distance, is not entirely confined to this genus, but takes place in some species of the genus scorpæna, as well as in that of trigla, and various others, as the reader may perceive in the prosecution of the present section.

The general length of the Mediterranean flying-fish is from twelve to fifteen or sixteen inches; and its general shape is not unlike that of a herring: the body is subcylindrical but with a slight approach to square, if a transverse section be supposed: the head is rather large, and sloping pretty suddenly in front: the mouth small, and edged on both jaws with minute, pointed teeth: the eyes large, and of a silver colour with a cast of gold: the scales are large, thin, and rounded: the whole animal is of a bright silvery cast, with a blue or dusky tinge on the upper part: the fins are also of a dusky colour: of these the pectoral extend as far as the beginning of the tail, and are of a sharply lanceolate form: the dorsal and anal fins are shallow, and placed opposite each other near the tail, which is deeply forked with sharp-pointed

* To this purpose I may quote the observation of an ingenious gentleman (Capt. G. Tobin), who had frequent opportunities of observing the habits of the flying-fish, and who thus expresses himself in a note annexed to a drawing of this species observed about the coasts of Otaheitee. "The lower half of the tail, in the flying-fish, is full twice the length of the upper: the use of it has always appeared evident to me. I have by the hour watched the dolphins and bonitos in pursuit of them; when, without wholly immersing themselves, which would have proved fatal to them, they have disposed in their progressive motion the lower part of the tail in such a manner as to supply their wings with moisture, so as to support them above the surface. I never saw one exceed the distance of one hundred yards in its flight, without being obliged to dip for a fresh supply."

lobes, of which the lower is nearly twice the length of the upper: the ventral fins are rather large, of a lengthened and pointed shape, and situated a little beyond the middle of the abdomen towards the anal fin: on each side the lower part of the abdomen runs a kind of carina or lateral line, formed by a series of small, inclining points, or spicules.

This species is frequently observed in the Mediterranean, sometimes singly, and sometimes appearing in small shoals. Instances are not unfreqnent of its falling into ships during the decline of its flight. It is considered as an agreeable fish for the table, and by some is even preferred to the herring. The general height at which it is observed to exercise its flight, is about three feet above the surface of the water.

[*Shaw.*

SECTION XIV.

Herring.

Clupea harengus.—Linn.

This fish, so eminently important in a commercial view, and which may justly be said to form one of the wonders of the northern world, is principally distinguished by the brilliant silvery colour of its body, the advancement of the lower jaw beyond the upper, and by the number of rays in the anal fin, which, in by far the greater number of specimens, are found to amount to seventeen*: the back is of a dusky blue or greenish cast, and in the recent or living fish the gill-covers are marked by a reddish, and sometimes by a violet-coloured spot: the eyes are large; the mouth without visible teeth; the openings of the gill-covers very large; the scales rather large, and easily desiduous; the lateral line not very distinctly visible; the abdomen pretty sharply carinated, and in some specimens, slightly serrated: the fins are rather small than large for the size of the fish, and the tail strongly forked. In size the herring is observed to vary greatly, and there are probably some permanent varieties of this species which yet want their exact description. The general size is perhaps from ten to twelve or thirteen inches.

* Mr. Pennant says fourteen: the number indeed is not absolutely onstant, but the most general appears to be seventeen.

Important as is this fish to the inhabitants of modern Europe, it is doubted whether it was distinctly known to the ancient Greeks and Romans: at least we find no certain description in their writings either of its forms or uses. The herring fishery however is of very considerable antiquity: the Dutch are said to have engaged in it so long ago as the year 1164, and were in possession of it for several centuries, and Flanders had the honour of discovering the method of preserving this fish by pickling it. One William Buekelin, of Biervelet, near Sluys, is said to have been the inventor of this useful expedient, and from him, according to Mr. Pennant, is derived the word *pickle*, which we have borrowed from the Dutch and Germans. Buekelin died in the year 1397. The Emperor Charles the Fifth is said to have held his memory in such veneration for the service he had done mankind, as to have paid a solemn visit to his tomb in honour of so distinguished a citizen. "The Dutch (says Mr. Pennant) are most extravagantly fond of fish when pickled; a premium is given to the first vessel that arrives in Holland laden with this their ambrosia: we have been in the country at that happy minute, and have observed as much joy among the inhabitants on its arrival, as the Egyptians shew at the first overflowing of the Nile."

Mr. Pennant, in his British Zoology, has so well detailed the general history of the herring, and its supposed migrations, that it is impossible to do better than to repeat his own words.

"The great winter rendezvous of the herring is within the Arctic circle: there they continue many months in order to recruit themselves after the fatigue of spawning, the seas within that space swarming with insect food in a far greater degree than in our warmer latitudes.

"This mighty army begins to put itself in motion in the spring: we distinguish this vast body by that name, for the word herring is derived from the German, heer, an army, to express their numbers.

"They begin to appear off the Shetland isles in April and May: these are only forerunners of the grand shoal which comes in June, and their appearance is marked by certain signs, by the numbers of birds, such as gannets and others, which follow to prey on them: but when the main body approaches, its breadth and depth is such as to alter the very appearance of the ocean. It is divided into distinct columns of five or six miles in length

and three or four in breadth, and they drive the water before them with a kind of rippling: sometimes they sink for the space of ten or fifteen minutes; then rise again to the surface, and in bright weather reflect a variety of splendid colours, like a field of the most precious gems; in which, or rather in a much more valuable light, should this stupendous gift of Providence be considered by the inhabitants of the British isles.

"The first check this army meets in its march southward, is from the Shetland isles, which divide it into two parts; one wing takes to the east, the other to the western shores of Great Britain, and fill every bay and creek with their numbers: others pass on towards Yarmouth, the great and ancient mart of herrings: they they then pass through the British channnel, and after that, in a manner disappear: those which take to the west, after offering themselves to the Hebrides, where the great stationary fishery is, proceed towards the North of Ireland, where they meet with a second interruption, and are obliged to make a second division: the one takes to the western side, and is scarce perceived, being soon lost in the immensity of the Atlantic; but the other, which passes into the Irish sea, rejoices and feeds the inhabitants of the coasts that border it.

"These brigades, as we may call them, which are thus separated from the greater columns, are often capricious in their movements, and do not shew an invariable attachment to their haunts."

The reality of the migration of the herring, so well detailed by Mr. Pennant, begins at present to be greatly called in question; and it is rather supposed that this fish, like the mackrel, is in reality at no very great distance during the winter months, from the shores which it most frequents at the commencement of the spawning season; inhabiting in winter the deep recesses of the ocean, or plunging itself beneath the soft mud at the bottom; but at the vernal season it begins to quit the deeper parts, and approach the shallows in order to deposit its spawn in proper situations; and this is thought a sufficient explanation of the glittering myriads which at particular seasons illumine the surface of the ocean for the length of several miles at once*. As a proof of this

* Herrings spawn at different seasons; some in spring, some in summer, and some in autumn.

Dr. Bloch observes, that herrings are in reality found at almost all seasons of the year about some of the European coasts; and that the northern voyages, supposed by Pennant and others, are impracticable in the short period assigned by naturalists; the fish, in its swiftest progress being utterly incapable of moving at so rapid a rate as this migration necessarily supposes. For these and other reasons Dr. Bloch is inclined to believe the long voyage of the herring to exist only in the minds of its describers.

Among the principal enemies of this fish may be numbered the various species of whales,* some of which are observed to pursue large shoals, and to swallow them in such quantities, that in the stomach of a single whale no less than six hundred herrings are said to have been found. Besides the whale, various species of marine birds of prey are perpetually assailing them, either on the water or from above. The herring itself is supposed to feed principally on sea-insects and the smaller kind of marine worms.

Exclusive of the various methods of preparing this fish for sale in different countries, a great quantity of oil is drawn from it, forming a great and important commercial article among the northern nations, and particularly among the Swedes.

[*Pennant. Shaw.*

SECTION XV.

Toad-Fish, or Angler.

Lophius piscatorius.—LINN.

THE genus lophius is remarkable for a peculiarly uncouth appearance; the body being thick and shapeless, and the fins short and broad: the largest of the genus is the lophius piscatorius, popularly known by the title of the frog-fish. It is an inhabitant of the European seas, where it sometimes arrives at a great size, having been seen to measure six or seven feet in length: its more general length however is from two to three or four feet. The shape bears some resemblance to that of a tadpole, the head being lost as it were in the outline of the sides, and the hind-parts tapering pretty suddenly towards the tail: the skin is smooth, but the upper parts of the animal are marked by various inequalities of

* Particularly a whale called the *Nord-Caper*, a very swift animal of the Orc tribe.

surface, rising here and there into the appearance of short spines: the eyes are large, and of a whitish colour, with the iris radiated by several dusky stripes: the mouth excessively wide, with the lower jaw considerably longer than the upper: the teeth very sharp and numerous, both in the mouth and on the tongue: from the upper part of the head spring two or three long and linear tentacula or processses, situated in a longitudinal direction behind each other, and followed by a few shorter ones down the back: the sides or edges of the body are fringed, at intervals, with many shorter appendages of a somewhat similar nature: the pectoral fins are large, of a rounded and slightly scolloped outline, and are seated on very thick arm-like processes: the ventral fins are short, cartilaginous, of a whitish colour, and palmated: the dorsal fin is rather shallow and situated at the lower part of the back: the ventral is placed nearly opposite and is of a similar appearance, but somewhat smaller: the tail is short and rounded. The colour of the whole animal on the upper parts is brown, with a few deeper and paler variegations, and beneath whitish. This fish is observed chiefly to frequent the shallow parts of the sea, lying in ambusk, half-covered by the weeds and mud; in this situation it is said to move about the tentacula or long processes on the head, &c. in such a manner that the smaller fishes, deceived by their resemblance to worms, and attempting to seize them, become an easy prey to the lophius. This practice, which is mentioned by Pliny and others, induced Mr. Pennant, in the British Zoology, to distinguish the genus by the English name of *angler*.

[*Willoughby. Pennant. Shaw.*

SECTION XVI.

Sucker.

Cyclopterus gumpus.—LINN.

THIS singular fish increases to the weight of seven pounds, and to the length of nineteen inches: the shape of the body is like that of the bream, deep, and very thick, and it swims edgeways: the back is sharp and elevated, the belly flat: the irides are of a cherry-colour, the lips, mouth, and tongue of a deeper red: the jaws lined with innumerable small teeth; the tongue very thick: along the ridge of the back is a row of large bony tubercles; from above the

eye to within a small space of the tail is another row; beneath that a third, commencing at the gills; and on each side the belly a fourth row, consisting of five tubercles like the other; the whole skin is rough, with small tubercles; on the upper part of the back is a thick ridge, improperly called a fin, being destitute of spines; beneath that is the dorsal fin, of a brownish hue, reaching within an inch of the tail; on the belly, just opposite, is another of the same form; the belly is of a bright crimson colour; the pectoral fins are large and broad, almost uniting at their base; beneath these is the part by which it adheres to the rocks, &c. it consists of an oval aperture, surrounded with a fleshy, muscular, and obtuse soft substance, edged with small threaded appendages, which concur as so many claspers: (tail and vent fins purple.) By means of this part it adheres with vast force to any thing it pleases: as a proof of its tenacity, we have known, that on flinging a fish of this species, just caught, into a pail of water, it fixed itself so firmly to the bottom, that on taking the fish by the tail, the whole pail was lifted, though it held some gallons, and that without removing the fish from its hold.

These fish resort in multitudes, during the spring, to the coast of Sutherland, near the Ord of Cathness. The seals, which swim beneath, prey greatly on them, leaving the skins; numbers of which, thus emptied, float at that season ashore. It is easy to distinguish the place where the seals are devouring this or any unctuous fish, by a smoothness of the water immediately above the spot: this fact is now established, it being a tried property of oil to still the agitation of the waves and render them smooth*. Great numbers of these fish are found in the Greenland seas, during the months of April and May, when they resort near the shore to spawn: their roe is remarkably large, which the Greenlanders boil to a pulp and eat: they are extremely fat, which recommends them the more to the natives, who admire oily food: they call them nipisets or catfish, and take quantities of them during the season. This fish is sometimes eaten in England, being stewed like carp, but is both flabby and insipid.

* See Phil. Trans. 1774. p. 445.

SECTION XVII.

Sturgeon.

Acipenser.—Linn.

There are five or six species belonging to this genus, all of which afford excellent food. The three following, however, are the chief.

1. *Common Sturgeon.*

Acipenser sturio.—Linn.

This is a fish of very great size, growing to the length of eighteen or twenty feet; it is an inhabitant of the Northern, European, and American seas, migrating, during the early summer months, into the larger rivers and lakes, and returning to the sea again in autumn, after having deposited its spawn. Its form is long and slender; the body pentagonal, gradually tapering towards the tail, and covered throughout the whole length by five rows of strong, large, bony tubercles, rounded at the base, radiated from the centre, and terminated above, by a sharp curved point, in a reversed direction; of these five rows of tubercles, one is situated on the top of the back, and two on each side the body, the lowermost forming the edges of the abdomen, which is flat; the whole skin also, except on the belly, is roughened by very small tubercles of similar structure; the head is rather large, sloping on each side, and covered with bony plates; the snout long and slender, obtuse at the tip, and furnished beneath, at some distance from the end, with four long, worm-shaped beards or cirrhi; the mouth is placed immediately beneath the upper part of the head, and consists of a transverse oval orifice, totally destitute of teeth, but containing a thick and strong tongue, and is bounded above and below by a strong, cartilaginous edge or lip, which it has the power of retracting or closing at pleasure; the gill-cover, on each side, consists of an oval, radiated plate; the pectoral fins are oval, and middle-sized; the dorsal small, and situated near the tail; the ventral and anal fins are also small, and placed nearly opposite the dorsal; the tail is lobed or slightly forked, the upper lobe being strengthened above by a bony ridge or carina, and extending far beyond the lower: the general colour is cinerous above, with

dusky variegations or specks, and whitish or yellowish beneath; the tops of the tubercles are also of a similar cast.

The sturgeon is generally considered as a fish of slow motion, and is observed to lie for a considerable time in the same situation; it even makes but a very faint resistance when first taken, except by sometimes striking with its tail; having great strength in that part; it is however, sometimes, seen to swim with considerable rapidity, and to spring with great force out of the water at intervals. During its residence in the sea, it is supposed to live principally on the smaller fishes, and particularly on herrings, mackrel, &c.; and in rivers on various kinds of worms, &c. It is rarely taken at any great distance from shore, but frequents such parts of the sea as are not remote from the æstuaries of great rivers. Catesby informs us, that in those of North America, sturgeons appear in great abundance in the months of May, June, and July, occasionally springing out of the water to the height of some yards, and falling on their sides with a noise that may be heard to the distance of some miles. In some of the rivers of Virginia, they are so numerous, that five or six hundred have been taken in the space of two days, by merely putting down a pole, with a strong hook at the end, and drawing it up again on perceiving that it rubbed against a fish *. According to Mr. Pennant and Dr. Bloch, great numbers are taken during summer in the lakes Frischhaff and Curischaff, near Pillau, in large nets made of small cord; the adjacent shores are formed into districts, and farmed out to companies of fishermen, some being rented for six thousand guilders, or near three hundred pounds per annum. Dr. Bloch informs us, that in France, the sturgeon-fishery commences in February, in the river Garonne, on the coast of Bourdeaux, and lasts till July or August.

The sturgeon is admired for the delicacy and firmness of its flesh, which is white, and when roasted is thought to resemble veal; it is however generally eaten pickled; and the major part of what we receive in that state, comes either from the Baltic rivers, or those of North America. Of the roe, properly salted and dried, is prepared the substance known by the name of caviare, a superior kind of which is, however, made from that of a smaller species, hereafter to be described.

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* Penn. Arct. Zool. Append. p. 106. Burnaby's Trav. 8vo. p. 15.

In our own country the sturgeon annually ascends rivers, but in no great quantity, and is occasionally taken in the salmon-nets; the largest recorded by Mr. Pennant, as taken in England, was of the weight of four hundred and sixty pounds. In its manner of breeding the sturgeon forms an exception among the cartilaginous fishes, since, as before observed, it is oviparous; it is a very prolific fish, and the globules of the roe or spawn are about the size of hemp-seeds.

The sturgeon was a fish in high repute among the Greeks and Romans; and, according to Pliny, was brought to table with much pomp, and ornamented with flowers, the slaves who carried it being also adorned with garlands, and accompanied by music. The flavour of the sturgeon is said to vary according to the food on which it has principally fed; for which reason it is distinguished in Sweden, and other northern regions, into mackrel-sturgeon, herring-sturgeon, &c. Dr. Bloch observes that the Linnæan specific character of this fish is not quite correct, since the number of dorsal tubercles varies from eleven to thirteen; neither is the number of the lateral or ventral rows more constant, varying in a similar manner. Some have supposed the tubercles of the sturgeon to be annually cast, in the same manner as those on rays. It may added that the sturgeon is able to survive some days when taken out of water; the gill-covers being edged by a soft membranaceous border, which by closing accurately, prevents the access of atmospheric air to the branchiæ.

2. *Isinglass Sturgeon.*

Acipenser huso.—Linn.

A still larger fish than the common sturgeon, having been often found of the length of twenty-five feet: general shape the same; colour dusky or blackish blue above, silvery on the sides and abdomen, with a tinge of rose-colour on the latter: general appearance smoother than in the common sturgeon, the dorsal tubercles being less protuberant, and those along the sides much smaller, and in some specimens of a very advanced growth altogether wanting: mouth much larger than in the A. sturio, with thick, crescent-shaped lips: skin smooth and viscid. Native of the Northern, Caspian, and Mediterranean seas, migrating from them into the adjoining rivers: found more particularly in the Volga and Danube.

It is from the sound, or air-bladder of this species, that the well-known substance called isinglass is prepared: this is done by cleansing, splitting, and drying that part, either in the air, or occasionally by a fire, and either twisting or flattening it, according to the particular sorts by which it is distinguished in commerce. An ample account of the preparation of this useful article, may be found in the sixty-third volume of the Philosophical Transactions: the skin, tail, stomach, and intestines of the fish are used for the same purpose; and indeed an isinglass, of a somewhat inferior kind, may be prepared from the same parts of many other fishes.

3. *Sterlet.*

Acipenser ruthenus.—LINN.

The sterlet is the smallest species of sturgeon yet discovered: in length, it rarely exceeds three feet, and is principally found in the Caspian sea, and the adjoining rivers Volga and Ural: it is also found, though much less frequently, in the Baltic sea. It is said to have been introduced into some of the large lakes of Sweden by Frederick the first; and into some parts of Brandenburg and Pomerania, by the King of Prussia. The head of this species is longer in proportion than in other sturgeons, and flattened both above and below: the body rather more slender; and the bony shields, with which the upper parts are covered, less protuberant, and of a thinner substance: along the belly are also disposed two ranges of small, flat shields: the general colour is dusky above; whitish, and variegated with rose coloured spots beneath: the rows of tubercles are of a yellow cast, and the whole skin is slightly roughened into a kind of scaly appearance: the ventral, and anal fins, are of a deep rose-colour: the rest blueish-brown: the usual number of shields, or tubercles, is, according to Dr. Bloch, fourteen along the back, and fifty-nine along each side.

The sterlet is in much higher esteem, as an article of food, than any other species, and is even considered as one of the most delicate of fishes. Sterlet soup, it is well known, formed one of the favourite luxuries of that gigantic epicure, Prince Potemkin, of Russia; who, in seasons when the fish happened to be dear, was content to purchase it at a price so extravagant, that a single tureen, forming the mere prelude to his repast, stood him in the sum of 300 rubles!

The sterlet indeed, in Russia, makes its appearance chiefly at the entertainments of the higher nobility; and the caviare, prepared from its roe, is said to be confined, almost exclusively, to the use of the royal table.

Like the rest of this genus, it is a prolific fish, and usually spawns in the months of May and June: it is said to live on worms and small fishes, and is particularly fond of the roe of the common sturgeon, for which reason, it often follows that species in its migrations. [*Shaw.*

SECTION XVII.

Large Shark.

Squalus corcharias.—LINN.

THE animals of the shark genus are altogether marine: and are said to be much rarer in the Baltic than in any other sea: they are viviparous, and are observed to produce more young at a time than the rays, but each included, as in those fishes, in a quadrangular capsule, or involucrum, each extremity of which is extended into a long, contorted, cartilaginous thread of great length. Many of the sharks are said to emit a phosphoric light during the night: they are chiefly of a solitary nature; and, in general, devour with indiscriminating voracity, almost every animal substance, whether living or dead: some few species, however, are observed to feed chiefly on fuci, and other marine vegetables.

The great or white shark, so remarkable for its vast size, and its powers of destruction, is an inhabitant of most parts of the globe, though much more frequently seen in the warmer than the colder latitudes: it is said to reside, principally, in the depths of the ocean, from whence it rises, at intervals, in order to prowl for prey, and is considered as the most voracious of all the inhabitants of the deep. It arrives at the length of more than thirty feet, and is of a somewhat thicker or broader form than most of the genus: the head is of a depressed shape, and broad; terminating in front in an obtusely pointed snout: the mouth is of vast width, and furnished, on the margin of each jaw, with from three to six rows of strong, flat, triangular, sharp-pointed, and finely serrated teeth, which are so imbedded in their investing cartilage, as to be either raised or depressed at pleasure: the tongue is broad, thick, and cartilaginous,

Engraved by Ramsay from a Drawing by Craig

For the Gallery of Nature & Art

THE SHARK ATTACKING A BOAT, THE DOLPHIN, AND FLYING FISH.

and the throat extremely wide: the eyes, as in most of the genus, of a blueish or greenish cast, rather small, and half overhung by their skinny veil: the pectoral fins are large, strong, broad, and pointed: the first dorsal fin moderately large, somewhat falcated behind, and pointed; the second is situated very low on the back, near the origin of the tail, which is slightly lengthened, and of a bilobate shape, the upper lobe or division slightly pointed, and the lower or terminal lobe rather rounded: so great is the strength of this part, that even a young shark, of about six feet in length, is able, by a stroke of its tail, to break a man's leg; it is usual, therefore, with sailors, to cut off the tail the instant they drag a shark on board: the anal fin is placed somewhat beyond the middle of the abdomen, and is of a moderate size, and of a somewhat square outline: the general colour of the whole animal is a pale or whitish ash, darker or browner on the upper parts; the mouth is situated considerably beneath the front, for which reason the animal is said like most others of this genus, to be obliged to turn on its back in order to seize its prey; an observation as ancient as the days of Pliny, "*resupinati vorant: affert moram providentia Naturæ, quia nisi resupini atque conversi, non corripiunt.*" Plin. lib. 9. c. 8. This, however, is much doubted by Dr. Bloch, who rather supposes the shark to seize its prey in a direct position, or like the generality of fishes. The skin of the shark is very rough, and is used as a kind of shagreen, as well as for smoothing various kinds of wood-work, &c. and from the liver is drawn a great quantity of oil.

"Sharks," says Mr. Pennant, "are the dread of sailors in all hot climates, where they constantly attend the ships, in expectation of what may drop overboard: a man that has that misfortune perishes without redemption: they have been seen to dart at him like gudgeons to a worm." They are said to attack Negroes in preference to Europeans; and are observed, in particular, to attend, with unremitting assiduity, the passage of the slave-ships, from the coasts of Africa to the West-Indian islands; and, as Cepede very happily and justly observes, may be considered as forming a proper escort to the cruel conductors of those most accursed vessels. "A master of a Guinea-ship," says Pennant, "informed me, that a rage of suicide prevailed among his new-bought slaves, from a notion the unhappy creatures had, that after death, they should be restored to their fa-

milies, friends, and country. To convince them that at least they should not reanimate their bodies, he ordered one of their corpses to be tied by the heels to a rope, and lowered into the sea; and though it was drawn up again as fast as the united force of the crew could be exerted, yet, in that short space, the sharks had devoured every part but the feet, which were secured at the end of the cord." Swimmers very often perish by them: sometimes they lose an arm or a leg, and sometimes are bit quite asunder, serving but for two morsels for this ravenous animal: a melancholy tale of this kind, is recited in a West-Indian ballad, preserved in Dr. Percy's Reliques of ancient English Poetry.

The size to which the Shark sometimes grows, is far superior to that mentioned in the former part of the present description: we are informed by Gillius, that a shark was seen of the weight of four thousand pounds, and that in the belly of one was found an entire human body; and Muller asserts, that in a shark taken at the isle of St. Margaret, was found a horse *, which had probably been thrown overboard from some ship. The size of the fossil teeth of this species, so often found in the isle of Malta, and elsewhere, affords a convincing proof of the enormous specimens which have once existed. In the British Museum are teeth of this kind, measuring at least four inches and a half from the point to the base, and six inches from the point to the corner: the animal, therefore, to which such teeth belonged, must have been equal to the largest of the cetacea in volume, and we may well admit the probability of a human body being swallowed by such a fish, not only entire, but without a wound; and on this supposition it is that the shark has been imagined by some to have been the fish ordained for the temporary confinement of the prophet Jonas †.

The internal parts of the shark present many remarkable particulars: the brain is small: the heart furnished with one ventricle, and one auricle, which latter is of a very large size, and receives the vena cava; the aorta, and other arteries, are of great strength;

* The shark does not spare even its own species. A Laplander, according to Leems, had taken a shark, and fastened it to his canoe; but soon missed it, without being able to guess how: in a short time afterwards he caught a second of much larger size, in which, when opened, he found the one he had lost.

† Jonam prophetam, ut veteres Herculem trinoctem, in hujus ventriculo tridui spatio hæsisse verosimile est. Lin. Syst. Nat.

the throat is very short, and of a diameter not greatly inferior to that of the beginning of the stomach, which is of vast size, and dilatable to a great degree: the intestinal canal consists of two portions; one analogous to the small, and the other to the large intestines of quadrupeds; but this latter portion is very short in proportion, and is so composed as to compensate by its interior structure for its brevity; since instead of forming a mere continued tube, as in most animals, it consists rather of a large series of meshes or divisions, placed in a spiral direction throughout its length: the liver is large, and divided into two unequal lobes: in the stomach and intestines, according to Commerson, are usually found a great many tæniæ, or tape-worms, which not only infest the cavities of these parts, but even penetrate into and lodge themselves between the interior coats: these animals therefore, by their vellication and motions, must be supposed to aggravate the natural voracity of the shark, and to impel it to engorge a large quantity of food, in order to allay the sensations excited by these internal enemies: the milt, in the male fish, is disposed into two portions, and equals the length of about a third of the whole animal; and, in the female, the ovaries are of a similar length: during the breeding-season, which takes place at different periods in different climates, the sharks are observed to approach the shores, in order to deposit their young in the most favourable situations: these are discharged, to the number of two or three at a time, still adhering to the capsule in which they had been before inclosed, and are excluded before the young animal has had time to break from it: the length of the newly-hatched shark does not exceed that of a few inches. [*Dr. Rondell. Pennant. Shaw.*

CHAP. V.

AMPHIBIALA.

Amphibia—LINN.

SECTION I.

Land Tortoise.

Testudo græca.

THE common or Greek Tortoise is supposed to be a native of almost all the countries bordering on the Mediterranean sea; and is thought to be more frequent in Greece than in other regions. It is found in the scattered European islands of the Archipelago, and in Corsica and Sardinia. It occurs likewise in many parts of Africa. In Greece, according to Forskal, " it forms an article of food; and the inhabitants often swallow the blood recent, and eat the eggs boiled, which are about the size of those of a pigeon, four or five in number, and of a white colour. In September the animal hides itself under ground, and again emerges in Febr ary*; laying its eggs in June, in a small hole, which it scratches in some sunny spot, out of which after the first rains of September, the young are hatched, which are about the size of a walnut. The males of this species are said to fight often, butting at each other with such force as to be heard at a considerable distance."

The general length of the shell of this species is from six to eight inches, which latter measure it rarely exceeds: the weight of the full-grown animal is about forty-eight ounces. The shell is of an oval form, extremely convex on the upper part, and composed, as in most others, of thirteen middle pieces, and about twenty-five marginal ones: the middle pieces, or those constituting the disk of the shield, are mostly of an oblong square form, and of a blackish or dark brown colour, varied by a broad yellow or citron band

* When kept in gardens in Italy and Germany, it is observed to latibulize in October, and to reappear in April. In England it retires about the end of October, and reappears about the middle of April; but these periods seem to differ in all countries, according to the temperature of the weather, &c.

running along one side of each, and continued about half way along the upper part: there is also an oblong patch of a similar colour, running down the lower part or side of each; and on the top or centre of each piece is an obscurely square or oblong space, rather more depressed than the rest, and marked, as in many other tortoise-shells, with roughish spots or granules: several furrows, more or less distinct in different individuals, appear traced round the sides of each piece, becoming gradually less distinct as they approach the upper part or space just mentioned. The colours of the shell are more or less bright in the different specimens, and are subject, as well as even the shape of the pieces themselves, to some occasional variations; and when very old, the shell becomes much smoother than in the younger animals, the sulci or furrows, as well as the areolæ or spaces on the top of each scutellum or piece, being almost obliterated. The under or belly part of the shell is of a citron or pale yellow colour, with a broad blackish or deep-brown zone down each side, leaving the middle part plain. The head is rather small than large; the eye small and black; the mouth not extending beyond the eyes; the upper part of the head covered with somewhat irregular, tough scales, and the neck with smaller granulations, so as to be flexible at the pleasure of the animal. The legs are short, and the feet moderately broad, covered with strong ovate scales, and commonly furnished with four moderately stout claws on each; but this is a circumstance which cannot be allowed to constitute a part of the specific character, since in different individuals, either from age, or other circumstances, these parts are found to vary in number, there being sometimes five claws instead of four on the fore feet. The tail is about the same length with the legs, or rather shorter, and is covered with small scales, and terminates in a naked horny pointed tip or process.

This animal lives to a most extraordinary age; several well attested examples being adduced of its having considerably exceeded the period of a century. One of the most remarkable instances is that of a tortoise introduced into the archiepiscopal garden at Lambeth, in the time of Archbishop Laud, and as near as can be collected from its history, about the year 1633, which continued to live there till the year 1753, when it was supposed to have perished rather from accidental neglect on the part of the gardener, than from the mere effect of age. This tortoise has had the honour of

being commemorated by Derham*, and many other writers, and its shell is preserved in the library of the palace at Lambeth†.

The general manners of the tortoise, in a state of domestication in this country, are very agreeably detailed by Mr. White, in his History of Selbourn. "A land tortoise," says Mr. White, "which has been kept thirty years in a little walled court, retires under ground about the middle of November, and comes forth again about the middle of April. When it first appears in the spring, it discovers very little inclination for food, but in the height of summer grows voracious; and then, as the summer declines, its appetite declines; so that for the last weeks in autumn it hardly eats at all. Milky plants, such as lettuces, dandelions, sowthistles, &c. are its principal food. On the first of November, 1771, I remarked that the tortoise began to dig the ground, in order to form its hybernaculum, which it had fixed on just beside a great tuft of Hepaticas. It scrapes out the ground with its fore feet, and throws it up over its back with its hind, but the motion of its legs is ridiculously slow, little exceeding the hour hand of a clock. Nothing can be more assiduous than this creature, night and day, in scooping the earth, and forcing its great body into the cavity; but as the noons of that season proved unusually warm and sunny, it was continually interrupted, and called forth by the heat in the middle of the day, and though I continued there till the thirteenth of November, yet the work remained unfinished. Harsher weather, and frosty mornings, would have quickened its operations. No part of its behaviour ever struck me more than the extreme timidity it always expresses with regard to rain; for though it has a shell that would secure it against the wheel of a loaded cart, yet does it discover as much solicitude about rain as a lady dressed in all her

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* In a copy of the work entitled Memoirs for the Natural History of Animals, from the French Academy, and which was once the property of Derham, the following MS. note occurs:

"I imagine land-tortoises, when arrived at a certain pitch, cease growing. For that I saw, Aug. 11, 1712, in my Lord Archbishop of Canterbury's Garden, which hath been there ever since Archbishop Juxon's time, and is accounted to be above 60 years old, was of the same size I have seen others of, of larger size, and much younger."

† This memorable tortoise appears to have exceeded the usual dimensions of its species; the shell measuring ten inches in length, and six and a half in breadth.

best attire, shuffling away on the first sprinklings, and running its head up in a corner. If attended to, it becomes an excellent weather-glass, for as sure as it walks elate, and, as it were on tip-toe, feeding with great earnestness, in a morning, so sure will it rain before night. It is totally a diurnal animal, and never pretends to stir after it becomes dark."

"The tortoise," adds Mr. W. "like other reptiles, has an arbitrary stomach, as well as lungs, and can refrain from eating, as well as breathing, for a great part of the year. I was much taken with its sagacity, in discerning those that do it kind offices; for as soon as the good old lady comes in sight, who has waited on it for more than thirty years, it hobbles towards its benefactress with awkward alacrity; but remains inattentive to strangers. Thus, not only "the ox knoweth his owner, and the ass his master's crib," but the most abject and torpid of beings distinguishes the hand that feeds it, and is touched with the feelings of gratitude. This creature not only goes under the earth from the middle of November to the middle of April, but sleeps great part of the summer; for it goes to bed in the longest days at four in the afternoon, and often does not stir in the morning till late. Besides, it retires to rest for every shower, and does not move at all in wet days. When one reflects on the state of this strange being, it is a matter of wonder that Providence should bestow such a seeming waste of longevity, on a reptile that appears to relish it so little as to squander away more than two thirds of its existence in a joyless stupor, and be lost to all sensation for months together, in the profoundest of all slumbers! Though he loves warm weather, he avoids the hot sun; because his thick shell, when once heated, would, as the poet says of solid armour, 'scald with safety.' He therefore spends the more sultry hours under the umbrella of a large cabbage-leaf, or amidst the waving forests of an asparagus bed. But as he avoids heat in the summer, so in the decline of the year, he improves the faint autumnal beams, by getting within the reflection of a fruit-tree wall; and though he has never read that planes inclining to the horizon receive a greater share of warmth, he inclines his shell by tilting it against the wall, to collect and admit every feeble ray."

The tortoise seems more tenacious of the vital principle than any other of the amphibia. Redi informs us, that in making some experiments on vital motion, he, in the beginning of November,

took a land tortoise, and made a large opening in its skull, and drew out all the brain, washing the cavity, so as to leave not the smallest part remaining, and then, leaving the hole open, set the animal at liberty. Notwithstanding this treatment, the tortoise marched away, without seeming to have received the smallest injury: it however closed its eyes, and never opened them afterwards. In a short space the hole of the skull was seen to close, and in about three days there was a complete skin covering the wound; and in this manner the animal lived, without the brain, for six months, walking about, and moving its limbs as before. Redi also cut off the head of a tortoise, which lived twenty-three days afterwards; and the head itself continued to snap the jaws for more than a quarter of an hour after its separation from the body. He repeated the experiment of taking out the brain upon several other tortoises, both of land and fresh water; all of which lived for a considerable space without the brain. He observed also, that having cut off the heads of some, and opening the bodies twelve days afterwards, the motion of the heart was still perceptible; so slowly is the vital principle discharged from these inactive animals.

[*Gmelin. Shaw.*

SECTION II.

Crocodile.

Lacerta crocodilus.—Linn.

The lacerta or lizard kind is a very numerous division; and comprises animals, possessing indeed much of the same general structure, but remarkably different in size and power: for to this division belong equally the crocodile and alligator; lizards of all sorts; the salamander, and chameleon, the newt and eft.

The crocodile, so remarkable for its size and powers of destruction, has in all ages been regarded as one of the most formidable animals of the warmer regions. It is a native of Asia and Africa, but seems to be most common in the latter; inhabiting large rivers, as the Nile, the Niger, &c. and preying principally on fish, but occasionally seizing on almost every animal which happens to be exposed to its rapacity. The size to which the crocodile sometimes arrives is prodigious; specimens being frequently seen of twenty feet in length, and instances are commemorated of some which

have exceeded the length of thirty feet. The armour with which the upper part of the body is covered may be numbered among the most elaborate pieces of nature's mechanism. In the full grown animal, it is so strong and thick as easily to repel a musket-ball; on the lower parts it is much thinner, and of a more pliable nature: the whole animal appears as if covered with the most regular and curious carved-work: the colour of a full-grown crocodile is blackish-brown above, and yellowish-white beneath; the upper parts of the legs and the sides varied with deep yellow, and in some parts tinged with green. In the younger animals the colour on the upper parts is a mixture of brown and pale yellow, the under parts being nearly white: the eyes are provided with a nictitating membrane, or transparent, moveable pellicle, as in birds: the mouth is of vast width, the rictus or gape having a somewhat flexuous outline, and both jaws being furnished with very numerous sharp-pointed teeth, of which those about the middle part of each jaw considerably exceed the rest in size, and seem analogous to the canine teeth in the viviparous quadrupeds or mammalia: the number of teeth, in each jaw, is thirty, or more *; and they are so disposed as to alternate with each other when the mouth is closed: on taking out the teeth and examining the alveoli, it has been found that small teeth were forming beneath, in order to supply the loss of the others when shed: the auditory forimana are situated on the top of the head, above the eyes, and are moderately large, oval, covered by a membrane, having a longitudinal slit or opening, and thus in some degree resembling a pair of closed eyes: the legs are short, but strong and muscular: the fore feet have five toes, and are unwebbed: the hind feet have only four toes, which are united towards their base by a strong web: the two interior toes on each of the fore feet, and the interior one of the hind feet, are destitute of claws †: on the other toes are strong, sharp, and curved claws: the tail is very long, of a laterally compressed form, and furnished

* The number is observed to vary in different specimens; probably from the different age of the animal. In the skeleton described by Grew, and which measured about fourteen feet in length, there were thirty teeth in each jaw, and those teeth which appeared to be the least worn, were serrated by small denticulations on each side.

† In the skeleton described by Grew there were claws on all the toes.

above with an upright process, formed by the gradual approximation of two elevated crests proceeding from the lower part of the back.

The crocodile, in a young state, is by no means to be dreaded, its small size and weakness preventing it from being able to injure any of the larger animals: it, therefore, contents itself with fish and other small prey; and such as have occasionally been brought to Europe are so far from being formidable or ferocious, that they may generally be handled with impunity; and either from weakness, or the effect of a cold climate, seem much inclined to torpidity; but in the glowing regions of Africa, where it arrives at its full strength and power, it is justly regarded as the most formidable inhabitant of the rivers. It lies in wait near the banks, and snatches dogs and other animals, swallowing them instantly, and then plunging into the flood, and seeking some retired part, where it may lie concealed till hunger again invites it to its prey. In its manner of attack it is exactly imitated by the common lacerta palustris, or water newt, which, though not more than about four or five inches long, will with the greatest ease swallow an insect of more than an inch in length; and that at one single effort, and with a motion so quick, that the eye can scarcely follow it. It poises itself in the water, and having gained a convenient distance, springs with the utmost celerity on the insect, and swallows it. If, therefore, a small lizard of four or five inches only in length can thus instantaneously swallow an animal of a fourth part of its own length, we need not wonder that a crocodile of eighteen, twenty, or twenty-five feet long, should suddenly ingorge a dog or other quadruped.

Crocodiles, like the rest of the lacertæ, are oviparous: they deposit their eggs in the sand or mud, near or on the banks of the rivers they frequent, and the young, when hatched, immediately proceed to the water; but the major part are said to be commonly devoured by other animals, as ichneumons, birds, &c. The egg of the common or Nilotic crocodile is not much larger than that of a goose, and in external appearance bears a most perfect resemblance to that of a bird; being covered with a calcareous shell, under which is a membrane. When the young are first excluded, the head bears a much larger proportion to the body than when full grown. The eggs, as well as the flesh of the crocodile itself,

are numbered among the delicacies of some of the African nations, and are said to form one of their favourite repasts.

The gradual evolution and growth of the crocodile are thus poetically described by Dr. Darwin:

"So from his shell, on Delta's showerless isle,
Bursts into birth the monster of the Nile;
First, in translucent lymph, with cobweb threads
The brain's fine floating tissue swells and spreads:
Nerve after nerve the glistening spine descends;
The red heart dances, the aorta bends:
Thro' each new gland the purple current glides,
New veins meand'ring drink the refluent tides.
Edge over edge expands each hardening scale,
And sheaths his slimy skin in silver mail.
Erewhile, emerging from the brooding sand,
With tiger paw he prints the brineless strand:
High on the flood with speckled bosom swims,
Helm'd with broad tail, and oar'd with giant limbs:
Rolls his fierce eye-balls, clasps his iron claws,
And champs with gnashing teeth his massy jaws.
Old Nilus sighs thro' all his cane-crown'd shores,
And swarthy Memphis trembles and adores.

In the large rivers of Africa crocodiles are said to be sometimes seen swimming together in vast shoals, and resembling the trunks of so many trees floating on the water. The negroes still sometimes attack and kill a single crocodile, by stabbing it under the belly, where the skin, at the interstices of the scales, is soft and flexible. It is also, in some countries, the custom to hunt the crocodile by means of strong dogs, properly trained to the purpose, and armed with spiked collars. It is likewise pretended, that in some parts of Africa crocodiles are occasionally tamed; and it is said that they form an article of royal magnificence with the monarchs of those regions; being kept in large ponds or lakes appropriated to their residence. We may add, that the ancient Romans exhibited these animals in their public spectacles and triumphs. Scaurus, during his ædileship, treated the people with a sight of five crodiles, exhibited in a temporary lake; and Augustus introduced one

into his triumph over Cleopatra, as well as several others, for the entertainment of the people.

A vulgar error seems to have long prevailed relative to this animal's moving his upper jaw. This error seems to have been first rectified by Grew, in his description of the skeleton of a crocodile in the Museum of the Royal Society. His words are these: "The articulations of the lower jaw with the upper, and of the occiput with the foremost vertebra of the neck, are here made both in the same manner, as in other quadrupeds, notwithstanding the tradition of his moving the upper jaw: the senselessness of this tradition is plain from the structure of the bones, that is, the articulation only of the occiput with the neck, and of the nether jaw with the upper, as abovesaid."

[*Grew. Shaw.*

SECTION III.

Alligator.

Lacerta alligator.—LINN.

So very great is the general resemblance between this animal and the crocodile, that many naturalists have been strongly inclined to consider it as a mere variety, rather than a distinct species. Among others, the Count de Cepede is of this opinion, and declares, that on examining several specimens of American crocodiles, and collating them with those of the Nile, he could not but consider them as absolutely of the same species; and that the slight differences observable between them may be well supposed to be owing merely to the effect of climate. Both animals, he observes, agree in the number of teeth; and the general manners and habits of both are found to be similar in the old and new continent. The more accurate discrimination, however, of Blumenbach and some others, seems in reality to prove that the alligator, or American crocodile, is specifically distinct from the Nilotic, though the difference is not such as immediately to strike a general observer. The leading difference, if it be allowed to constitute a distinction of species, seems to be, that the head of the alligator is rather smooth on the upper part, than marked with those very strong rugosities and hard carinated scales which appear on that of the crocodile; and that the snout is considerably flatter and wider, as well as more rounded at the ex-

tremity. The alligator arrives at a size not much inferior to that of the crocodile, specimens having been often seen of eighteen or twenty feet in length.

"Though the largest and greatest numbers of alligators," says Catesby, "inhabit the torrid zone, the continent abounds with them ten degrees more north, particularly as far as the river Neus, in North Carolina, in the latitude of about 33, beyond which I have never heard of any, which latitude nearly answers to the northermost parts of Africa, where they are likewise found. They frequent not only salt rivers near the sea, but streams of fresh water in the upper parts of the country, and in lakes of salt and fresh water, on the banks of which they lie lurking among reeds, to surprise cattle and other animals. In Jamaica, and many parts of the continent, they are found about twenty feet in length: they cannot be more terrible in their aspect, than they are formidable and mischievous in their natures, sparing neither man nor beast they can surprise, pulling them down under water, that being dead, they may with greater facility, and without struggle or resistance, devour them. As quadrupeds do not so often come in their way, they almost subsist on fish; but as Providence, for the preservation, or to prevent the extinction of defenceless creatures, hath in many instances restrained the devouring appetites of voracious animals, by some impediment or other, so this destructive monster, by the close connexion of his vertebræ, can neither swim nor run any way than strait forward, and is consequently disabled from turning with that agility requisite to catch his prey by pursuit: therefore they do it by surprise in the water as well as by land; for effecting which, nature seems in some measure to have recompensed their want of agility, by giving them a power of deceiving and catching their prey by a sagacity peculiar to them, as well as by the outer form and colour of their body, which on land resembles an old dirty log or tree, and in the water frequently lies floating on the surface, and there has the like appearance, by which, and his silent artifice, fish, fowl, turtle, and other animals are deceived, suddenly catched and devoured.

"Carnivorous animals get their food with more difficulty and less certainty than others, and are often necessitated to fast a long time, which a slow concoction enables them to endure: reptiles particularly, by swallowing what they eat whole, digest slowly, eat

seldom, and live long without food. Wolves are said to gorge themselves with mud, to supply the want of better food. For the like cause many alligators swallow stones and other substances, to distend and prevent the contraction of their intestines when empty, and not to help digestion, which they seem in no need of. For in the greater number of many I have opened, nothing has appeared but clumps of light wood and pieces of pine tree coal, some of which weighed eight pounds, and were reduced and wore so smooth from their first angular roughness, that they seemed to have remained in them many months. They lay a great number of eggs at one time, in the sandy banks of rivers and lakes, which are hatched by the heat of the sun without further care of the parents. The young, as soon as they are disengaged from their shells, betake themselves to the water, and shift for themselves; but while young they serve as a prey not only to ravenous fish, but to their own species. It is to be admired that so vast an animal should at first be contained in an egg no bigger than that of a turkey."

"In South Carolina they are very numerous, but the northern situation of that country occasions their being of a smaller size than those nearer the line, and they rarely attack men or cattle, yet are great devourers of hogs. In Carolina they lie torpid from about October to March, in caverns and hollows in the banks of rivers, and at their coming out in the spring, make an hideous bellowing noise. The hind part of their belly and tail are eat by the Indians. The flesh is delicately white, but has so perfumed a taste and smell that I never could relish it with pleasure."

[*Shaw. Catesby.*

SECTION IV.

Chameleon.

Lacerta chamæleon.—LINN.

FEW animals have been more celebrated by natural historians than the chameleon, which has been sometimes said to possess the power of changing its colour at pleasure, and of assimilating it to that of any particular object or situation. This, however, must be received with very great limitations; the change of colour which the animal exhibits varying in degree, according to circumstances

of health, temperature of the weather, and many other causes, and consisting chiefly in a sort of alteration of shades from the natural greenish or blueish grey of the skin into pale yellowish, with irregular spots or patches of dull red; but not justifying the application of the Ovidian distich.

> "Non mihi tot cultus numero comprendere fas est;
> Adjicit ornatus proxima quæque dies."

> No numbers can the varying robe express,
> While each new day presents a different dress.

It is also to be observed, that the natural or usual colour of chameleons varies very considerably; some being much darker than others, and it has even been seen approaching to a blackish tinge. An occasional change of colour is likewise observable, though in a less striking degree, in some other lizards.

The general length of the chameleon, from the tip of the nose to the beginning of the tail, is about ten inches, and the tail is of nearly similar length, but the animal is found of various sizes, and sometimes exceeds the length above mentioned. It is a creature of a harmless nature, and supports itself by feeding on insects; for which purpose the structure of the tongue is finely adapted, consisting of a long, missile body, furnished with a dilated and somewhat tubular tip, by means of which the animal seizes insects with great ease, darting out its tongue in the manner of a woodpecker, and retracting it instantaneously with the prey secured in its tip. It can also support a long abstinence, and hence arose the popular idea of the chameleon being nourished by air alone. It is found in many parts of the world, and particularly in India and Africa. It is also sometimes seen in the warmer parts of Spain and Portugal.

The chameleon, by the power which it possesses in common with most other amphibia, of inflating its lungs and retaining the air for a great length of time, appears occasionally of a plump or fleshy aspect, while at other times, on evacuating the air from its lungs and keeping them in a collapsed state, it appears in the utmost degree of extenuation, as if consisting of little more than a mere skin, the ribs being completely visible on each side of the body. The skin on every part of the animal is of a granulated

structure, the granules differing in size on different parts, from that of a small pin's head to the diameter of the tenth of an inch, or even more, especially on the edges of the projecting parts of the head and jaws. Down the back runs a series of obscure denticulations or slight projections, forming a carina on that part. The feet consist each of five toes, three and two of which on each foot are connate, or united as far as the claws by a common skin: on the fore feet the two outward and three inward toes are united; and in the hind feet the two inward and three outward. The motions of the chameleon are extremely slow, and in sitting on a branch, or in passing from one to another, it fastens itself by coiling its tail round that from which it means to pass, till it has perfectly secured the other with its feet.

The general or usual changes of colour in the chameleon, so far as I have been able to ascertain from my own observation of such as have been brought into this country in a living state, are from a blueish ash-colour (its natural tinge) to a green and sometimes yellowish colour, spotted unequally with red. If the animal be exposed to a full sunshine, the unilluminated side generally appears, within the space of some minutes, of a pale yellow, with large roundish patches or spots of red-brown. On reversing the situation of the animal the same change takes place in an opposite direction; the side which was before in the shade now becoming either brown or ash-colour, while the other side becomes yellow and red; but these changes are subject to much variety both as to intensity of colours and disposition of spots.

The following is the description given by the anatomists of the French Academy:

"The colour of all the eminences of our chameleon when it was at rest, in the shade, and had continued a long time undisturbed, was a blueish grey, except under the feet, where it was white inclining to yellow, and the intervals of the granules of the skin were of a pale and yellowish red. This grey, which coloured all the parts exposed to the light, changed when in the sun; and all the places of its body which were illuminated, instead of their blueish colour, became of a brownish grey, inclining to a minime. The rest of the skin, which was not illuminated by the sun, changed its grey into several brisk and shining colours, forming spots about half a finger's breadth, reaching from the crest of the

spine to the middle of the back: others appeared on the ribs, fore legs, and tail. All these spots were of an Isabella colour, through the mixture of a pale yellow with which the granules were tinged, and of a bright red, which is the colour of the bottom of the skin which is visible between the granules: the rest of the skin not enlightened by the sun, and which was of a paler grey than ordinary, resembled a cloth made of mixed wool; some of the granules being greenish, others of a minime-grey, and others of the usual blueish grey, the ground remaining as before. When the sun did not shine, the first grey appeared again by little and little, and spread itself all over the body, except under the feet, which continued of the same colour, but a little browner; and when, being in this state, some of the company handled it, there immediately appeared on its shoulders and fore legs several very blackish spots about the size of a finger nail, and which did not take place when it was handled by those who usually took care of it. Sometimes it was marked with brown spots, which inclined towards green. We afterwards wrapped it up in a linen cloth, where having been two or three minutes, we took it out whitish; but not so white as that of which Aldrovandus speaks, which was not to be distinguished from the linen on which it was laid. Ours, which had only changed its ordinary grey into a very pale one, after having kept this colour some time, lost it insensibly. This experiment made us question the truth of the Chameleon's taking all colours but white; as Theophrastus and Plutarch report; for ours seemed to have such a disposition to retain this colour, that it grew pale every night; and when dead, it had more white than any other colour: nor did we find that it changed colour all over the body, as Aristotle reports; for when it takes other colours than grey, and disguises itself, to appear in masquerade, as Ælian pleasantly says, it covers only certain parts of the body with them. Lastly, to conclude the experiments relative to the colours which the Chameleon can take, it was laid on substances of various colours, and wrapped up therein; but it took not them as it had done the white; and it took that only the first time the experiment was made, though it was repeated several times on different days.

"In making these experiments, we observed that there were a great many places of its skin which grew brown, but very little at a time: to be certain of which we marked with small specks of ink

those granules which to us appeared whitest in its pale state; and we always found that when it grew brownest, and its skin spotted, those grains which we had marked, were always less brown than the rest."

[*Shaw. Mem. del' Acad. Royal.*

SECTION V.

Salamander.

Lacerta salamander.—LINN.

THE Salamander, so long the subject of popular error, and of which so many idle tales have been recited by the more ancient naturalists, is an inhabitant of many parts of Germany, Italy, France, &c. but does not appear to have been discovered in England. It delights in moist and shady places, woods, &c. and is chiefly seen during a rainy season. In the winter it lies concealed in the hollows about the roots of old trees; in subterraneous recesses, or in the cavities of old walls, &c. The Salamander is easily distinguished by its colours; being of a deep shining black, variegated with large, oblong, and rather irregular patches of bright orange-yellow, which, on each side the back, are commonly so disposed as to form a pair of interrupted longitudinal stripes: the sides are marked by many large, transverse, wrinkles, the intermediate spaces rising into strongly marked convexities; and the sides of the tail often exhibit a similar appearance; on each side the back of the head are situated a pair of large tubercles, which are in reality the parotid glands, and are thus protuberant not only in some others of the Lizard tribe, but in a remarkable manner in the genus Rana: these parts, as well as the back and sides of the body, are beset in the salamander with several large open pores or foramina, through which exsudes a peculiar fluid, serving to lubricate the skin, and which, on any irritation, is secreted in a more sudden and copious manner under the form of a whitish gluten, of a slightly acrimonious nature; and from the readiness with which the animal, when disturbed, appears to evacuate it, and that even occasionally to some distance, has arisen the long-continued popular error of the salamander's being enabled to live uninjured in the fire, which it has been supposed capable of extinguishing by its natural coldness, and moisture: the real fact is,

that, like any of the cold and glutenous animals, as snails, &c. it, of course, is not quite so instantaneously destroyed by the force of fire as an animal of a drier nature would be. The general length of the salamander is about seven or eight inches, though it sometimes arrives at a much larger size: in the number and form of its spots it varies considerably, and is occasionally seen entirely black: the tail is somewhat shorter* than the body, and of a round or cylindric form, gradually tapering to the extremity, which is rather obtuse than sharp. Like other lizards of this tribe, the salamander lives principally on insects, small snails, &c. its tongue, however, is not so formed as to catch these in a sudden manner, being short, broad, and in some degree confined, so as not to be darted out with celerity. It is capable of living in water as well as on land, and is sometimes found in stagnant pools, &c. Its general pace is slow, and its manners torpid.

A strange error appears to have prevailed relative to the supposed poisonous nature of this animal, and the malignity of its venom has even been considered as scarcely admitting a remedy. On this subject the writings of Gesner and Aldrovandus afford ample information; but it is useless, as well as unpleasing, in these days of general illumination, to detail the absurd and erroneous doctrines of past ages. It may be sufficient to observe, that the salamander is perfectly innoxious, and incapable of inflicting either wound or poison on any of the larger animals; though it appears, from the experiments of Laurenti, that the common small grey lizard (L. agil. var.) is poisoned by biting a salamander, and thus swallowing the secreted fluid of the skin; becoming almost immediately convulsed, and dying in a very short time afterwards.

The salamander is a viviparous species; producing its young perfectly formed, having been first hatched from internal eggs, as in the viper, and some other amphibia. It is said to retire to the water in order to deposit its young, which, at their first exclusion, are furnished with ramified† branchial fins or processes on each side the

* It is remarkable, that in the beautiful representation of this animal in the frontispiece to Roesel's Historia Ranarum; the tail is longer than the body; but this must be considered as a rare occurrence.

† On this subject some confusion and disagreement will be found to take place in the works of different naturalists; Mr. Latreille seems to doubt very much whether the salamander really produces her young in the water, as well as whether they are at first furnished with ramified branchial fins.

neck, and which being merely temporary organs, are afterwards obliterated, as in the young of frogs and water-newts. The number of young produced at one birth by the salamander, is said sometimes to amount to thirty or forty.

[*Latreille. Shaw.*

SECTION VI.

Frog. Toad.

Rana.—LINN.

THIS genus is also numerous, though considerably less so than the preceding. The three following species are, perhaps, mostly worth noticing.

1. *Common Frog.*

Rana temporaria.—LINN.

This is the most frequent of all the European species, being almost every where seen in moist situations, or wherever it can command a sufficient quantity of insects, worms, &c. on which it feeds. In colour it varies considerably, but its general tinge is olive-brown, variegated, on the upper parts of the body and limbs, with irregular blackish spots; those on the limbs being mostly disposed in a transverse direction: beneath each eye is a longish mark or patch, reaching to the setting on of the fore-legs, and which seems to form one of its principal specific distinctions.

It is generally in the month of March that the frog deposits its ova or spawn, consisting of a large heap or clustered mass of gelatinous transparent eggs, in each of which is imbedded the embryo, or tadpole, in the form of a round black globule. The spawn commonly lies more than a month, or sometimes five weeks, before the larves or tadpoles are hatched from it; and during this period each egg gradually enlarges in size, and a few days before the time of exclusion, the young animals may be perceived to move about in the surrounding gluten. When first hatched, they feed on the remains of the gluten in which they were imbedded; and in the space of a few days, if narrowly examined, they will be found to be furnished, on each side of the head, with a pair of ramified branchiæ or temporary organs, which again disappear after a certain space.

These tadpoles are so perfectly unlike the animals in their complete state, that a person not conversant in natural history would hardly suppose them to bear any relationship to the frog; since, on a general view, they appear to consist merely of head and tail. Their motions are extremely lively, and they are often seen in such vast numbers as to blacken the whole water with their legions. They live on the leaves of duckweed and other small water-plants, as well as on various kinds of animalcules, &c. and when arrived at a larger size, they may even be heard to gnaw the edges of the leaves on which they feed, their mouths being furnished with extremely minute teeth or denticulations. The tadpole is also furnished with a small kind of tubular sphincter or sucker, beneath the lower jaw, by the help of which it hangs at pleasure to the under surface of the aquatic plants, &c. From this part it also occasionally hangs, when very young, by a thread of gluten, which it seems to manage in the same manner as some of the smaller slugs have been observed to practise. Its interior organs differ, if closely inspected, from those of the future frog, in many respects; the intestines in particular are always coiled into a flat spiral, in the manner of a cable in miniature.

When the tadpoles have arrived at the age of about five or six weeks, the hind legs make their appearance, gradually increasing in length and size; and, in about a fortnight afterwards, or sometimes later, are succeeded by the fore legs, which are indeed formed beneath the skin much sooner, and are occasionally protruded, and again retracted by the animal, through a small foramen on each side of the breast, and are not completely stretched forth till the time just mentioned. The animal now bears a kind of ambiguous appearance, partaking of the form of a frog and a lizard. The tail at this period begins to decrease, at first very gradually, and at length so rapidly as to become quite obliterated in the space of a day or two afterwards. The animal now ventures upon land, and is seen wandering about the brinks of its parent waters, and sometimes in such multitudes as to cover a space of many yards in extent. This is the phenomenon which has so frequently embarrassed the minds not only of the vulgar, but even of some superior characters in the philosophic world; who, unable to account for the legions of these animals with which the ground is occasionally covered in certain spots, at the close of summer, have been led into

the popular belief of their having descended from the clouds in showers.

As soon as the frog has thus assumed its perfect form, it feeds no longer on vegetables, but on animal food; supporting itself on small snails, worms, &c. and insects. For the readier obtaining its prey, the structure of its tongue is extremely well calculated, being so situated that the root is attached to the fore rather than the hind part of the mouth; and when at rest, lies backwards, as if the animal was swallowing the tip. By this means the creature is enabled to throw it out to some distance from the mouth, which is done with great celerity, and the bifid and glutinous extremity secures the prey, which is swallowed with an instantaneous motion, so quick that the eye can scarcely follow it.

The frog can hardly be said to arrive at its full size till the age of about five years, and is supposed to live at least twelve or fifteen years.

The frog is extremely tenacious of life, and, like other amphibia, will survive for a considerable space the loss of many of its organs. If confined entirely under water, it is still enabled to support its existence for several days, as appears by Sir Thomas Brown's experiment, who kept a frog under water six days. On the contrary, it cannot so well dispense with the want of water, and is unable to survive too long an exposure to a dry air and a hot sun. It is, therefore, particularly careful to secure a retreat where it may enjoy the benefit of shade and a sufficient supply of moisture. It delights, however, to bask occasionally in a moderate sunshine, and is unable to support severe cold.

Tree-Frog.

Rana arborea.—LINN.

In the beauty of its colours, as well as in the elegance of its form, and the agility of its movements, the tree-frog exceeds every other European species. It is a native of France, Germany, Italy, and many other European regions, but is not found in the British islands. Its principal residence, during the summer months, is on the upper parts of trees, where it wanders among the foliage in quest of insects, which it catches with extreme celerity, stealing

softly towards its prey in the manner of a cat towards a mouse, and when at the proper distance, seizing it with a sudden spring, frequently of more than a foot in height. It often suspends itself to the under parts of the leaves, thus continuing concealed beneath their shade. Its size is smaller than any other European frog, except the fire-frog. Its colour on the upper parts is green, more or less bright in different individuals; the abdomen is whitish, and marked by numerous granules; the under surface of the limbs is reddish, and the body marked on each side by a longitudinal blackish or violet-coloured streak. The body is smooth above, and moderately short; the hind legs are very long and slender; the fore feet have four and the hind feet five toes, all of which terminate in rounded, flat, and dilated tips, the under surface of which, being soft and glutenous, enables the animal to hang with perfect security from the leaves of trees, &c. The skin of the abdomen is also admirably calculated by nature for this peculiar power of adhesion, being covered with small glandular granules, in such a manner as to fasten closely even to the most polished surface; and the animal can adhere at pleasure to that of glass, in whatever position or inclination it is placed, by merely pressing itself against it.

Though the tree-frog inhabits the woods, during the summer months, yet on the approach of winter it retires to the waters, and there submerging itself in the soft mud, or concealing itself beneath the banks, remains in a state of torpidity, and again emerges in the spring, at which period it deposits its spawn in the waters, like the rest of this genus. During their residence among the trees, they are observed to be particularly noisy on the approach of rain; so that they may be considered, in some measure, as a kind of living barometers; more especially the males, which, if kept in glasses, and supplied with proper food, will afford an infallible presage of the changes of the weather.

3. *Toad.*

Rana bufo.—Linn.

Of all the European toads, this seems to be the most universally known: at least, in its complete or perfect form. It is found in gardens, woods, and fields; and frequently makes its way into cellars, or any obscure recesses in which it may occasionally conceal itself, and where it may find a supply of food, or a security from

too great a degree of cold. In the early part of spring, like others of this genus, it retires to the waters, where it continues during the breeding-season, and deposits its ova or spawn in the form of double necklace-like chains or strings of beautifully transparent gluten, and of the length of three or four feet.

The toad is an animal too well known to require any very particular description of its form. It may be necessary to observe that it is always covered by tubercles, or elevations on the skin, of larger or smaller size in different individuals; and that the general colour of the animal is an obscure brown above, much paler and irregularly spotted beneath.

The toad arrives at a considerable age; its general term of life being supposed to extend to fifteen or even twenty years: and Mr. Pennant, in his British Zoology, gives us a curious account, communicated by a Mr. Arscott, of Tehott, in Devonshire, of a toad's having lived, in a kind of domestic state, for the space of more than forty years, and of having been in a great degree tamed, or reclaimed from its natural shyness or desire of concealment; since it would always regularly come out of its hole at the approach of its master, &c. in order to be fed. It grew to a very large size, and was considered as so singular a curiosity, that even ladies, laying aside their usual aversion and prejudices, requested to see the favourite toad. It was, therefore, often brought to table, and fed with various insects, which it seized with great celerity, and without seeming to be embarrassed by the presence of company. This extraordinary animal generally resided in a hole beneath the steps of the house-door, fronting the garden; and might, probably, have survived many years longer, had it not been severely wounded by a raven, which seized it before it could take refuge in its hole; and notwithstanding it was liberated from its captor, it never again enjoyed its usual health, though it continued to live above a year after the accident happened.

With respect to the supposed venomous qualities of the toad, from the experiments of Laurenti, it appears that small lizards, on biting the common toad, were for some time disordered and paralytic, and even appeared to be dead, but in a few hours were completely recovered.

It is also observed, that dogs, on seizing a toad, and carrying it for some little time in their mouth, will appear to be affected with a very slight swelling of the lips, accompanied by an increased eva-

cuation of saliva; the mere effect of the slightly acrimonious fluid which the toad, on irritation, exsudes from the skin, and which seems, in this country at least, to produce no dangerous symptoms in such animals as happen to taste or swallow it. The limpid fluid also, which this animal discharges when disturbed, is a mere watery liquor, perfectly free from any acrimonious or noxious qualities, and appearing to be no other than the contents of a peculiar reservoir, common to this tribe, destined for some purpose in the economy of the animals which does not yet appear to be clearly understood. The common toad may therefore be pronounced innoxious, or perfectly free from any poisonous properties, at least with respect to any of the larger animals; and the innumerable tales recited by the older writers of its supposed venom, appear to be either gross exaggerations, or else to have related to the effects of some other species mistaken for the common toad; it being certain that some of this genus exsude from their skin a highly acrimonious fluid.

It might seem unpardonable to conclude the history of this animal, without mentioning the very extraordinary circumstance of its having been occasionally discovered enclosed or imbedded, without any visible outlet, or even any passage for air, in the substance of wood, and even in that of stone or blocks of marble.

On this subject a curious experiment was made by Mons. Herrissant, of the French Academy, in consequence of an assertion, that in the year 1771, on pulling down a wall at a seat belonging to the Duke of Orleans, and which had been built forty years, a living toad had been found in it; its hind feet being confined or imbedded in the mortar. M. Herrissant therefore, in the presence of the academy, inclosed three toads in as many boxes, which were immediately covered with a thick coat of plaster or mortar, and kept in the apartments of the academy. On opening these boxes eighteen months afterwards, two of the toads were found still living: these were immediately re-inclosed; but on being again opened some months after, were found dead. These experiments are, perhaps, not very conclusive; and only appear to prove what was before well known, viz. that the toad, like many other amphibia, can support a long abstinence, and requires but a small quantity of air: but in the accounts generally given of toads discovered in stones, wood, &c. the animals are said to have been completely impacted or imbedded, and without any space for air.

[*Herrissant. Mem. de l'Acad. Royal. Shaw.*

SECTION VII.

Siren.

Siren lacertina.—Linn.

Mud-Inguana.—Ellis.

This species stands eminently distinguished in the list of animals by the ambiguity of its characters, which are such as to have induced the great Linnæus to institute it for a new order of amphibia, under the title of meantes *; an order, however, which does not stand among the rest of the amphibia in the Systema Naturæ, but is mentioned in a note at the end of the second part of the first volume of that work.

The genus with which the siren has evidently the greatest possible affinity, is the lacerta, or lizard. It even very much resembles the larve, or first state of a lacerta; and it is still doubtful whether it may not really be such: yet it has never been observed in any other state, having two feet only, without any appearance of a hind pair: the feet are also furnished with claws, whereas the larves of all the lacertæ are observed to be without claws; or, in the Linnæan phrase, *digitis muticis:* the mouth has several rows of smallish teeth: the body is eel-shaped, but slightly flattened beneath; marked on the sides by several wrinkles, and slightly compressed towards the extremity of the tail, which is edged with a kind of soft skin, or adipose fin, as it were: on each side the neck are three ramified branchial processes, resembling, on a larger scale, those belonging to the larves of water newts, and at the base are the openings into the gills; the eyes are very small, and blue. The general colour of the animal is a deep or blackish brown, scattered over, especially on the sides, with numerous minute whitish specks. Its size nearly equals that of an eel, being frequently found of the length of more than two feet. It is a native of North America, and more particularly of South Carolina, where it is not very uncommon in muddy and swampy places, living generally under water, but sometimes appearing on land. It has a kind of squeaking or singing voice, for which reason Linnæus distinguished it by the title of siren.

* The characters of this order are thus given by Linnæus, viz. branchiæ and pulmones simul. Pedes brachiati, unguiculati. The generic character stands thus, viz. corpus bipedum, caudatum, nudum. Pedes brachiati, unguiculati.

This curious animal was first discovered and described by the ingenious Dr. Garden, who resided many years in Carolina, and who paid particular attention to the science of Natural History, which he enriched by many highly interesting observations. Dr. Garden communicated specimens of the siren to Linnæus, with particulars relative to its history and manners. Linnæus, in his letter to Dr. Garden on this subject, declares, that nothing had ever exercised his thoughts so much, nor was there any thing he so much desired to know, as the real nature of so extraordinary an animal.

The celebrated anatomist, Camper, seems to have deceived himself in a singular manner, in his examination of this extraordinary animal; asserting that it was destitute of lungs; and, in consesequence, considering it as breathing by gills alone, in the manner of fish, regarded it as a species of muræna siren. The opinion of Camper, however, is now allowed to be erroneous; and the siren is unquestionably most allied to the lizard tribe; though it still remains doubtful whether it should be considered as a larve, or as an animal in its perfect or ultimate form.

The lightness with which the Count de Cepede passes over this interesting subject, cannot be observed without surprise; I have surveyed, says he, with attention the figure of this animal in the Philosophical Transactions, as well as its description by Mr. Ellis, and have not a moment's hesitation in pronouncing it to be merely the larve of a lacerta.

"Nous avons examiné avec soin la figure et la description que M. Ellis en a données dans les Transactions Philosophiques; & nous n'avons pas douté un seul moment que cet animal, bien loin de constituer un ordre nouveau, ne fût une larve."

How different this from the sober investigation and philosophical doubts of the great Linnæus, as well as from the patient enquiries of a Hunter and a Camper!

The celebrated Amphibiologist, Schneider, after declaring his own opinion, that the siren is really no other than the larve of some undiscovered lizard, thus expresses his sentiments relative to the Count de Cepede's decision on the subject.

"Factum igitur casu potius puto, ut suspicio Galli de Sirene lacertina Linnæi proposita, p. 611 *, tam bene caderet, nec a scopo veritatis plane aberraret †."

* Histoire Naturelle des Quadrupedes ovipares.

† Schneid. Amph. fasc. 1. 41.

It remains to be added, that the siren, if thrown on the ground with any degree of violence, has been observed to break in two or three places; in this particular resembling the anguis frigalis, or slow-worm. It is also proper to observe, that no lizard of which it may be supposed the larve, has ever yet been discovered in those parts of Carolina where it is most frequent. The species to which it seems most allied is the lacerta teguixin of Linnæus, which is a native of South America.

[*Shaw. Schneider. Camper. Ellis.*

SECTION VIII.

Rattle-Snake

Crotalus horridus.—LINN.

THE genus crotalus, or rattle-snake, affords the most signal examples of the powerfully destructive poison with which some of the serpent tribe are furnished; instances having frequently occurred in which the bite of these snakes has proved fatal to mankind in the space of even a very few minutes.

Till the discovery of the western hemisphere, the knowledge of these serpents was concealed from the rest of the world, and philosophers then first beheld, with amazement, a reptile of the most fatal nature, furnished, as if by a peculiar institution of providence, with an instrument capable, in general, of warning mankind of their danger in too near an approach.

The different species of rattle-snakes seem to have been generally confounded with each other; and even Catesby, who travelled in those parts of North America where it is found, seems to have been unacquainted with one of the most remarkable species, and to have particularly described the banded rattle-snake only, which he has also figured with sufficient clearness to prevent its being confounded with any other kind, though not with that minute attention to all the particulars which the more improved state of Natural History at present demands.

This species is found, in general, from three to four or five feet in length, and is of a yellowish brown colour, marked throughout its whole length, with several transverse and somewhat irregular fasciæ of deep brown; and from the head, to some distance down

Engraved by Scott from a Drawing by Craig

For the Gallery of Nature & Art

RATTLE SNAKE, HORNED SNAKE, & WALKING LEAF.

the neck, run two or three longitudinal stripes of the same colour; the head is large, flat, and covered with small scales; the rest of the upper parts with moderately large oval ones, all strongly carinated or furnished with a prominent line down the middle: the under parts are of a dingy yellowish brown colour, marked here and there with numerous dusky variegations and freckles: at the extremity of the tail is situated the rattle, consisting of several hard, dry, horny processes, the peculiar structure of which will be more amply described hereafter, and which, on the least disturbance or irritation, is elevated and shaken in such a manner as to cause a strong or brisk rattling sound.

"The largest rattle-snake," says Catesby, "which I ever saw, was about eight feet in length, and weighing between eight and nine pounds. This monster was sliding into the house of Colonel Blake, of Carolina, and had certainly taken up his abode there undisturbed, had not the domestic animals alarmed the family with their repeated outcries: the hogs *, dogs, and poultry, united in their hatred to him, shewing the greatest consternation, by erecting their bristles and feathers, and expressing their wrath and indignation, surrounded him, but carefully kept their distance; while he, regardless of their threats, glided slowly along." "It is not uncommon," adds Mr. Catesby, "to have them come into houses; a very extraordinary instance of which happened to myself in the same gentleman's house, in the month of February, 1723; the servant in making the bed in a ground room, (but a few minutes after I left it) on turning down the sheets, discovered a rattle-snake coiled between the sheets in the middle of the bed." "They are the most inactive and slow moving snake," adds this author, "of all others, and are never the aggressors, except in what they prey upon; for unless they are disturbed they will not bite, and when provoked they give warning by shaking their rattles. These are commonly believed to be the most deadly serpent of any in these parts of America. I believe they are so, as being generally the largest, and making a deeper wound, and injecting a greater quantity of poison. The most successful remedy the Indians seem to have, is to suck the wound, which in a slight bite has sometimes a good effect; though the re-

* Hogs, however, are, in general, said to be so little afraid of the rattle-snake, that they prey on it occasionally with great eagerness; seizing it in such a manner as to prevent it from doing them any injury, and devouring it.

covered person never fails of having annual pains* at the time they were bit. They have likewise some roots which they pretend will effect a cure, particularly a kind of asarum, commonly called heart-snake-root, a kind of chrysanthemum, called St. Anthony's cross, and some others: but that which they rely on the most, and which most of the Virginian and Carolina Indians carry dry in their pockets, is a small tuberous root, which they procure from the remote parts of the country. This they chew, and swallow the juice, applying some to the wound. Having, by travelling much with the Indians, had frequent opportunities of seeing the direful effects of the bites of these snakes, it always seemed and was apparent to me, that the good effect usually attributed to these their remedies, is owing more to the force of nature, or the slightness of the bite of a small snake in a muscular part, &c. The person thus bitten I have known to survive without assistance many hours; but where a rattle-snake, with full force penetrates his deadly fangs, and pricks a vein or an artery, inevitable death ensues, and that, as I have often seen, in less than two minutes. The Indians know their destiny the minute they are bit, and when they perceive it mortal, apply no remedy, concluding all efforts in vain: if the bite happeneth in a fleshy part, they immediately cut it, to stop the current of the poison.

"The colour of the head of this rattle-snake is brown, the eye red, the upper part of the body of a brownish yellow, transversely marked with irregular broad black lists. The rattle is usually of a brown colour, composed of several horny membraneous cells, of an undulated pyramidal figure, which are articulated one with another, so that the point of the first cell reaches as far as the basis or protuberant ring of the third, and so on; which articulation being very loose, gives liberty to the parts of the cells that are inclosed within the outward rings, to strike against the sides of them, and so to cause the rattling noise which is heard when the snake shakes its tail.

"The charming, as it is commonly called, or attractive power this snake is said to have, of drawing to it small animals, and devouring them, is generally believed in America; as for my own part I never saw the action, but a great many from whom I had it related, all agree in the manner of the process; which is, that the animals,

* This may perhaps be considered as doubtful, or may depend on other circumstances than the bite of the rattle-snake.

particularly birds and squirrels, (which principally are their prey,) no sooner spy the snake, than they skip from spray to spray, hovering and approaching gradually nearer to their enemy, regardless of any other danger; but with distracted gestures and outcries, descend, though from the top of the loftiest trees, to the mouth of the snake, who openeth his jaws, takes them in, and in an instant swallows them."

On this subject Dr. Mead, in his work on poisons, expresses himself as follows:

"With respect to the use of the rattle, a vulgar error has obtained, even among the learned, about it. It is commonly said that it is a kind contrivance of divine Providence, to give warning to passengers by the noise which this part makes when the creature moves, to keep out of the way of its mischief. Now this is a mistake. It is beyond all dispute that wisdom and goodness shine forth in all the works of the creation; but the contrivance here is of another kind than is imagined. All the parts of animals are made either for the preservation of the individual, or for the propagation of its species; this before us is for the service of the individual. This snake lives chiefly upon squirrels and birds, which a reptile can never catch without the advantage of some management to bring them within its reach. The way is this. The snake creeps to the foot of a tree, and, by shaking his rattle, awakens the little creatures which are lodged in it. They are so frighted at the sight of their enemy, who fixes his lively piercing eyes upon one or other of them, that they have no power to get away, but leap about, from bough to bough, till they are quite tired, and at last, falling to the ground, they are snapped into his mouth. This is by the people of the country called charming the squirrels and birds."

Dr. Barton, professor of natural history, in the University of Pensylvania, in a memoir on the supposed fascinating power of the rattle-snake, imagines the whole to be no more than the fluttering of old birds in defence of their young, and which are themselves occasionally caught by the rattle-snake, in consequence of too near an approach.

"Of the fascinating power of the rattle-snake," says Mr. Pennant*, "it is difficult to speak; authors of credit describe the

* Arct. Zool. suppl. 88.

effects. Birds have been seen to drop into its mouth, squirrels descend from their trees, and leverets run into its jaws. Terror and amazement seem to lay hold on these little animals: they make violent efforts to get away, still keeping their eyes fixed on those of the snake; at length, wearied with their movements, and frightened out of all capacity of knowing the course they ought to take, become, at length, the prey of the expecting devourer; probably in their last convulsive motion." The same author observes, that rattle-snakes, in general, swarm in the less inhabited parts of North America; but are now almost extirpated in the more populous parts. None are found farther north than the mountains near Lake Champlain; but infest South America, even as far as Brazil. They love woods and lofty hills, especially where the strata are rocky or chalky; the pass near Niagara abounds with them. Being slow of motion, they frequent the sides of rills, to make prey of frogs, or such animals as resort there to quench their thirst; are generally found during summer in pairs; in winter collecting in multitudes, and retiring under ground, beyond the reach of frost; tempted by the warmth of a spring day, they are often observed to creep out weak and languid; a person has seen a piece of ground covered with them, and killed with a rod between sixty and seventy; till overpowered with the stench, he was obliged to retire *.

The rattle-snake is a viviparous animal; producing its young in the month of June, generally about twelve in number; and which by September acquire the length of twelve inches. It is said to practise the same extraordinary mode of preserving its young from danger which is attributed to the viper in Europe, viz. of receiving them into its mouth and swallowing them. Of this we have the attestation of M. de Beauvois †, who declares himself an eye-witness of the process. This gentleman saw a large rattle-snake, which he happened to disturb in his walks, and which immediately coiled itself up, opened its jaws, and instantly five small ones, which were lying by it, rushed into its mouth. The author retired and watched the snake, and in a quarter of an hour saw her again discharge them. He then approached it a second time, when the young retired into its mouth with greater celerity than before, and the snake immediately moved off among the grass and escaped. This happened at a place

* Arct. Zool. suppl. p. 88.

† American Phil. Trans. vol. iv.

called Pine-Log, where M. de Beauvois staid some time with the Indians, during an illness with which he was seized. M. de Beauvois adds, that in winter the rattle-snake retires into deep mossy loose soils beneath trees, &c. as well as in holes under ground.

From experiments made in Carolina by Captain Hall, and related in the Philosophical Transactions, it appears that a rattle-snake of about four feet long, being fastened to a stake fixed in the ground, bit three dogs, the first of which died in less than a quarter of a minute: the second, which was bitten a short time afterwards, in about two hours, in convulsions; and the third, which was bitten about half an hour afterwards, shewed the visible effects of the poison in about three hours, and died likewise. Four days after this, another dog was bitten, which died in half a minute; and then another, which died in four minutes. A cat which was bitten was found dead the next day. Eight days after this a frog was bitten, which died in two minutes, and a chicken of three months old in three minutes. The experiments having been discontinued some time for want of subjects, a common black snake was procured, which was healthy and vigorous, and about three feet long. It was brought to the rattle-snake, when they bit each other, the black snake biting the rattle-snake so as to make it bleed. They were then separated, and in less than eight minutes the black snake died; while the rattle-snake, on the contrary, shewed no signs of indisposition, appearing as well as before. Lastly, in order to try whether the rattle-snake could poison itself, it was provoked to bite itself. The experiment succeeded, and the animal expired in less than twelve minutes.

According to experiments made by Mr. Vosmaer, at the Hague, with a lively young rattle-snake, which he received from Surinam, small birds, such as sparrows, greenfinches, &c. died sometimes in four, sometimes in ten, and sometimes in twenty minutes after having been bitten, and a mouse in a minute and a half.

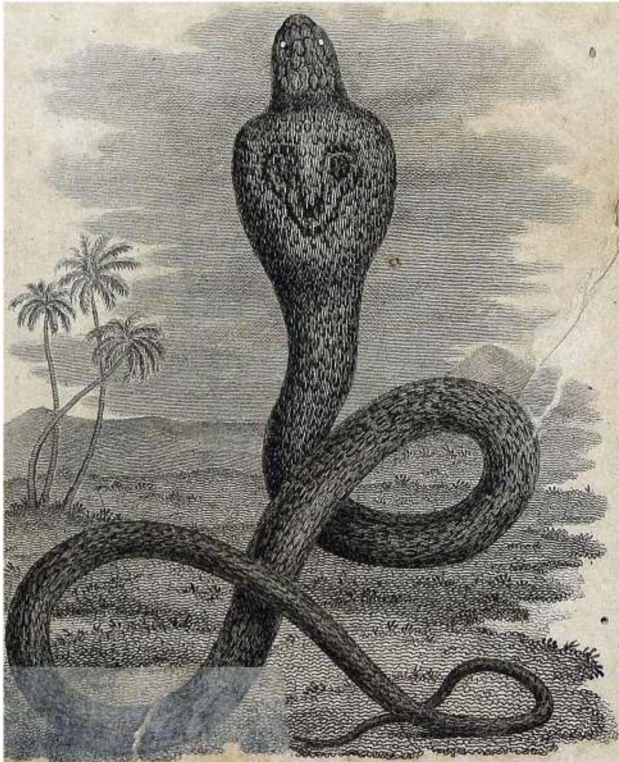
The anatomy of the rattle-snake is described, with much exactness, by Dr. Tyson, in the Philosophical Transactions. From this it appears, that the teeth are of two sorts, viz. the smaller, which are seated in each jaw, and serve for the catching and retaining of food; and, secondly, the fangs or poisonous teeth, which kill the prey, and are placed without the upper jaw, and are all canini or apprehensores; for since snakes do not chew or bruise their food, but swallow it whole, they have no need of molars or grinders.

Of the first sort of teeth are two rows on each side, viz. five in a row, the inward less than the outward, there being twenty in all. In the upper jaw there are only sixteen, viz. five on each side, placed backward, and six before. These do no harm, which was known of old to mountebanks, who, to give a proof of the efficacy of their antidotes, would suffer themselves to be bitten by vipers, but first took care to spoil them of their fangs.

The fangs are placed without the upper jaws, towards the fore part of the mouth, not fastened to the maxillæ, as the other teeth, but the two outmost and largest fangs were fixed to that bone, which may be thought to be the ear-bone; the other fangs, or smaller ones, seemed not fixed to any bone, but rather to muscles and tendons. The fangs were not to be perceived on first opening the mouth, lying couched under a strong membrane or sheath; but so as to make a large rising there on the outside of the smaller teeth of the maxilla; but at pleasure, when alive, the animal can raise them to do execution with, as a cat or lion does its claws. These fangs were hooked and bent, like the tusks of the babyroussa, but some of the smaller ones were bent at right angles; on each side we meet with about six or seven of these. In all these teeth was a pretty large foramen or hole towards the root of it, and towards the point was a plainly visible large slit, sloping like the cut of a pen; the part from the slit being perfectly hollow; and on pressing gently with the finger on the side of the gum, the poison, which was of a yellowish colour, was readily perceived to issue from the hollow of the tooth through the slit.

The vertebræ, according to the figure of the body, were smallest towards both extremes, and largest in the middle. From the neck to the vent there were as many vertebræ as scales on the belly, viz. 168; but from the vent to the setting on of the rattle were twenty-nine more in number than the scales.

The rattle is well described by Dr. Grew, who observes that it consists of hollow, hard, dry, and semitransparent bones, nearly of the same size and figure; resembling in some degree the shape of the human os sacrum; for although only the last or terminal one seems to have a rigid epiphysis joined to it, yet have every one of them the like; so that the tip of every uppermost bone runs within two of the bones below it; by which artifice they have not only a moveable coherence, but also make a more multiplied sound; each bone hitting against two others at the same time.



Engraved by Angus from Drawings

COBRA DE CAPELLO: OR

Spectacle Snake.

For the Gallery of Nature & Art.

BOA CONSTRICTOR SNAKE.

Seizing a Horse.

Engraved by Scott from a Drawing by Thurston — For the Gallery of Nature & Art.

SURINAM SNAKE.

Crotalus Mutus, *LINN.* Crotaline Boa, *SHAW.*

The rattle is placed with the broad part perpendicular to the body, and not horizontal; and the first joint is fastened to the last vertebra of the tail by means of a thick muscle under it, as well as by the membranes which unite it to the skin; all the remaining joints are so many extraneous bodies, as it were, or perfectly unconnected to the tail by any other means than their curious insertions into each other.

The number of joints in the rattle of different individuals is very various, from five to twelve, fifteen, twenty, or even, according to some accounts, as many as forty. The pieces of which it consists are successively formed, each having been once attached to the muscle of the last vertebra of the tail, and driven on by the gradual formation of a young or immature one beneath it; but as it is not known whether these successive formations of new joints in the rattle correspond with the general changes of the skin, and as the part is also liable from its nature to occasional mutilations, it cannot be considered as a proper test of the animal's age.

The length of the individual dissected by Dr. Tyson, was four feet five inches; the girth of the body in the largest part six inches and a half; that of the neck three inches, and of the extremity of the tail, near the rattle, two inches.

[*Catesby. Tyson. Grew. Phil. Trans. Shaw.*

SECTION IX.

Great Boa.

Boa constrictor.—LINN.

The genus boa is remarkable for the vast and almost unlimited size of some of the principal species, which in India, Africa, and South America, are occasionally found of not less than twenty, thirty, and even thirty-five feet in length, and of a strength so prodigious as to be able to destroy cattle, deer, &c. by twisting around them in such a manner as to crush them to death by continued pressure *, after which they will swallow them in a very gradual manner;

* This practice of larger serpents seems to have been well known to the ancients; thus Lucan, speaking of the monstrous African snakes, (which he also represents as furnished with wings,) tells us they destroy oxen, and even elephants, by writhing around and crushing them to death.

"Vos quoque, qui cunctis innoxia numina terris
Serpitis, aurato nitidi fulgore Dracones,

and when thus gorged with their prey, become almost torpid with repletion, and if discovered in this state, may without much difficulty be destroyed by shooting or other methods. There is reason to suppose, that these gigantic serpents are become less common now than some centuries backwards; and that in proportion as cultivation and population have increased, the larger species of noxious animals have been expelled from the haunts of mankind, and driven into more distant and uncultivated tracts: they are still, however, occasionally seen, and sometimes approach the plantations and gardens of the districts nearest to their residence.

Of all the larger Boæ the most conspicuous is the Boa Constrictor, which is at once pre-eminent from superiority of size and beauty of colours: in this respect indeed it appears to be subject to considerable variation from age, sex, and climate, but may be distinguished in every state from the rest of its tribe by the peculiar pattern or disposition of its variegations. The ground-colour of the whole animal, in the younger specimens, is a yellowish grey, and sometimes even a bright yellow, on which is disposed along the whole length of the back a series of large, chain-like, reddish-brown, and sometimes perfectly red variegations, leaving large open spaces of the ground colour at regular intervals; the largest or principal marks composing the chain-like pattern above mentioned are of a squarish form, accompanied on their exterior sides by large triangular spots, with their points directed downwards;

Pestiferos ardens facit Africa, ducitis altum
Aera cum pennis, armentaque tota secuti
Rumpitis ingentes amplexi verbere tauros.
Nec tutus spatio est Elephas; datis omnia leto;
Nec vobis opus est ad noxia fata veneno."

Ye too, in other climes who harmless rove
In gilded scales, the guardians of the grove,
In horrid Afric's pestilential air
Acquire new natures from the burning glare;
Ride thro' the blaze of noon on sable wing,
Quick on th' affrighted herds with fury spring;
And gathering all your folds in writhings dire,
Bid the huge ox beneath your crush expire;
Th' enormous elephant by force can slay,
And need no poison to secure your prey.

The tale of Laocoon, in Virgil, might be also adduced as an example of this particular.

between these larger marks are disposed many smaller ones of uncertain forms, and more or less numerous in different parts; the ground-colour itself is also scattered over by a great many small specks, of the same colour with the variegations; the exterior edges of all the larger spots and markings are commonly blackish, or of a much deeper cast than the middle part, and the ground colour immediately accompanying the outward edges of the spots is, on the contrary, lighter than on other parts, or even whitish, thus constituting a general richness of pattern, of which nothing but an actual view of a highly-coloured specimen of the animal itself can convey a complete idea. In larger specimens, the yellow tinge is often lost in an uniform grey cast, and the red tinge of the variegations sinks into a deep chesnut; and in some the general regularity of the pattern before described is disturbed by a kind of confluent appearance; the head is always marked above by a large longitudinal dark band, and by a narrower lateral band passing across the eyes towards the neck.

The boa constrictor is a native of Africa, India, the larger Indian islands, and South America, where it chiefly resides in the most retired situations in woody and marshy regions.

It was, in all probability, an enormous specimen of this very serpent that once diffused so violent a terror amongst the most valiant of mankind, and threw a whole Roman army into dismay. Historians relate this surprising event in terms of considerable luxuriance. Valerius Maximus thus mentions it from Livy, in one of the lost books of whose history it was related more at large.

"And since we are on the subject of uncommon phænomena, we may here mention the serpent so eloquently and accurately recorded by Livy; who says, that near the river Bagrada, in Africa, a snake was seen of so enormous a magnitude as to prevent the army of Attilus Regulus from the use of the river; and after snatching up several soldiers with his enormous mouth, and devouring them, and killing several more by striking and squeezing them with the spires of its tail, was at length destroyed by assailing it with all the force of military engines and showers of stones, after it had withstood the attack of their spears and darts: that it was regarded by the whole army as a more formidable enemy than even Carthage itself; and that the whole adjacent region being tainted with the pestilential effluvia proceeding from its remains, and the

waters with its blood, the Roman army was obliged to remove its station: he also adds, that the skin of the monster, measuring 120 feet in length, was sent to Rome as a trophy."

The learned Frienshemius, in his Supplementa Liviana, has attempted a more ample and circumstantial narrative of the same event, and it cannot be unacceptable to the reader to receive a quotation from an author who has so happily imitated the manner of the great historian.

"In the mean time Regulus, every where victorious, led his army into a region watered by the river Bragrada, near which an unlooked for misfortune awaited them, and at once affected the Roman camp with considerable loss, and with apprehensions still more terrible; for a serpent of prodigious size attacked the soldiers who were sent for water, and while they were overwhelmed with terror, and unequal to the conflict, engulphed several of them in its enormous mouth, and killed others by writhing round them with its spires, and bruising them with the strokes of its tail: and some were even destroyed by the pestilential effluvia proceeding from its breath: it caused so much trouble to Regulus, that he found it necessary to contest the possession of the river with it by employing the whole force of his army, during which a considerable number of soldiers were lost, while the serpent could neither be vanquished nor wounded; the strong armour of its scales easily repelling the force of all the weapons that were directed against it; upon which recourse was had to battering engines, with which the animal was attacked in the manner of a fortified tower, and was thus at length overpowered. Several discharges were made against it without success, till its back being broken by an immense stone, the formidable monster began to lose its powers, and was yet with difficulty destroyed; after having diffused such a horror among the army, that they confessed they would rather attack Carthage itself than such another monster: nor could the camp continue any longer in the same station, but was obliged to fly; the water, and the whole adjacent region, being tainted with the pestiferous effluvia. A most mortifying humiliation to human pride. Here, at least, was an instance of a whole Roman army, under the command of Regulus, and universally victorious both by sea and land, opposed by a single snake, which conflicted with it when living, and even when dead obliged

it to depart. The proconsul, therefore, thought it no diminution to his dignity to send the spoils of such an enemy to Rome, and to confess at once the greatness of his victory, and his terror by this public memorial: for he caused the skin of the snake to be taken off, and sent to the city, which is said to have measured 120 feet: it was suspended in a temple, and remained till the time of the Numantine war."

[*La Cepede. Friensheim. Shaw.*

SECTION X.

Cerastes, or Horned Snake.

Coluber cerastes.—Linn.

The cerastes or horned viper, which commonly grows to the length of about a foot or fifteen inches, and sometimes to a larger size*, is distinguished by a pair of horns or curved processes, situated above the eyes, and pointing forwards: these horns have nothing analogous in their structure to the horns of quadrupeds, and are by no means to be considered in the light of either offensive or defensive weapons: they increase, however, the natural antipathy so generally felt against the serpent tribe, and give the animal a more than ordinary appearance of malignity. The cerastes is a native of many parts of Africa, and is principally found in sandy deserts and dry places. Its usual colour is a pale yellowish or reddish brown, with a few rather large, distant, round, or transversely oblong spots of a deeper colour dispersed along the upper parts of the body, the belly or under part being of a pale lead colour. In Syria and Arabia the cerastes is particularly frequent, and is also found in many parts of Egypt, &c. It bears a very great affinity to the common viper, and its bite is perhaps still more to be dreaded, since exclusive of the general danger of treading accidentally on this reptile, and thus irritating it unawares, it is said to possess a propensity of springing with great suddenness to a considerable distance, and assailing without provocation those who happen to approach it.

The general history and manners of this serpent are amply de-

* The specimens described by Cepede measured more than two feet, as does also that in the British Museum.

tailed by Mr. Bruce, who, in the course of his travels, had frequent opportunities of contemplating it in its native regions.

" The cerastes," says Mr. Bruce, " inhabits the greatest part of the Eastern Continent, especially the desert sandy part of it. It abounds in the three Arabias, and in Africa. I never saw so many of them as in the Cyrenaicum, where the Jerboa is frequent in proportion. He is a great lover of heat; for though the sun was burning hot all day, when we made a fire at night, by digging a hole, and burning wood to charcoal in it, for dressing other victuals, it was seldom we had fewer than half a dozen of these vipers, who burnt themselves to death by approaching the embers. The general size of the cerastes, from the extremity of its snout to the end of the tail, is from thirteen to fourteen inches; its head is triangular, very flat, but higher near where it joins the neck than towards the nose: the length of its head, from the point of the nose to joining of the neck, is ten twelfths of an inch, and the breadth nine twelfths: between its horns is three twelfths: the opening of its mouth, or rictus oris, is eight twelfths: its horns in length three twelfths: its large canine teeth something more than three twelfths and a half: its neck, at the joining of the head, four twelfths: the body, where thickest, ten twelfths: its tail, at the joining of the body, two twelfths and a half: the tip of the tail one twelfth: the length of the tail one inch and three twelfths: the aperture of the eye two twelfths, but this varies, apparently according to the impression of light. The cerastes has sixteen small, immoveable teeth, hollow, crooked, inwards, and of a remarkably fine polish, white in colour, inclining to blueish; near one fourth of the bottom is strongly fixed in the upper jaw, and folds back like a clasp knife, the point inclining inwards, and the greatest part of the tooth is covered with a green, soft membrane, not drawn tight, but as it were wrinkled over it; immediately above this is a slit along the back of the tooth, which ends nearly in the middle of it, where the tooth curves inwardly. From this aperture I apprehend that it sheds its poison, not from the point, where, with the best glasses, I could never perceive an aperture, so that the tooth is not a tube, but hollow only half way; the point being for making the incision, and by its pressure occasioning the venom in the bag at the bottom of the fang, to rise in the tooth, and spill itself through the slit into the wound. By this flat position of the tooth along the jaw, and its being defended by the mem-

brane, it eats in perfect safety; for the tooth cannot press the bag of poison at the root while it lies in this position, nor can it rise in the tube to spill itself, nor can the tooth make any wound, so as to receive it; but the animal is supposed to eat but seldom, or only when it is with young. This viper has only one row of teeth; none but the canine are noxious. The poison is very copious for so small a creature, it is fully as large as a drop of laudanum dropt from a vial by a careful hand. Viewed through a glass, it appears not perfectly transparent or pellucid. I should imagine it hath other reservoirs than the bag under the tooth, for I compelled it to scratch eighteen pigeons upon the thigh as quickly as possible, and they all died nearly in the same interval of time; but I confess the danger attending the dissection of the head of this creature made me so cautious, that any observation I should make upon these parts would be less to be depended upon.

"People have doubted whether or not this yellow liquor is the poison, and the reason has been, that animals who had tasted it, did not die as when bitten, but this reason does not hold good in modern physics. We know why the saliva of a mad dog has been given to animals, and has not affected them; and a German physician was bold enough to distil the pus or putrid matter flowing from the ulcer of a person infected by the plague, and taste it afterwards, without bad consequences; so that it is clear the poison has no activity till through some sore or wound it is admitted into the circulation. Again, the tooth itself, divested of that poison, has as little effect. The viper deprived of his canine teeth, an operation very easily performed, bites, without any fatal consequence, with the others; and many instances there have been of mad dogs having bit people cloathed in coarse woollen stuff, which had so far cleaned the teeth of the saliva in passing through it, as not to have left the smallest inflammation after the wound.

"The cerastes is mentioned by name in Lucan, and without warranting the separate existence of any of the rest, I can see several that are but the cerastes under another term: the thebanus ophites, the ammodytes, the torrida dipsas, and the prester, all of them are but this viper, described from the form of its parts or colours*. Cato must have been marching in the night when he met this army of serpents: the cerastes hides itself all day in holes in the sand, where it lives in contiguous and similar houses to those

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* Luc. lib. 9.

of the jerboa; and I have already said, that I never but once found any animal in the viper's belly, but one jerboa in a gravid female cerastes.

"I kept two of these last mentioned creatures in a glass jar, such as is used for keeping sweetmeats in, for two years, without having given them any food; they did not sleep, that I observed, in winter, but cast their skins the last days of April. The cerastes moves with great rapidity, and in all directions, forward, backward, and sideways. When he inclines to surprise any one, who is too far from him, he creeps with his side towards the person, and his head averted, till judging his distance, he turns round, springs upon him, and fastens upon the part next to him; for it is not true what is said, that the cerastes does not leap or spring. I saw one of them at Cairo, in the house of Julian and Rosa, crawl up the side of a box, in which there were many, and there lie still as if hiding himself, till one of the people who brought them to us, came near him, and though in a very disadvantageous posture, sticking, as it were, perpendicular to the side of the box, he leaped near the distance of three feet, and fastened between the man's fore-finger and thumb, so as to bring the blood. The fellow shewed no sign of either pain or fear, and we kept him with us full four hours, without his applying any sort of remedy, or his seeming inclined so to do. To make myself assured that the animal was in its perfect state, I made the man hold him by the neck, so as to force him to open his mouth, and lacerate the thigh of a pelican, a bird I had tamed, as big as a swan. The bird died in about thirteen minutes, though it was apparently affected in fifty seconds; and we cannot think this was a fair trial, because, a very few minutes before it had bit the man, and so discharged part of its virus; and it was made to scratch the pelican by force, without any irritation or action of its own.

"I apprehend this to be the aspic, which Cleopatra employed to procure her death. Alexandria, plentifully supplied by water, must then have had fruit of all kinds in its gardens: the basket of figs must have come from thence, and the aspic or cerastes that was hid in them, from the adjoining desert, where they are plenty to this day; for to the westward in Egypt, where the Nile overflows, there is no sort of serpents whatever that I ever saw; nor, as I have before said, is there any other of the mortal kind that I know, in those parts of Africa adjoining to Egypt, excepting the ce-

rastes. It should seem very natural for any one, who, from motives of distress, has resolved to put a period to his existence, especially women, and weak persons, unaccustomed to handle arms, to seek the gentlest method to free themselves from the load of life now become insupportable. This, however, has not always been the case with the ancients. Arria, Pœtus's wife, stabbed herself with a dagger, to set her husband an example to die, with this memorable assurance, after giving herself the blow, *Pœtus, it is not painful!* Porcia, the wife of Brutus, died by the barbarous, and not obvious way of perishing, by swallowing fire; the violent agitation of spirits prevailing over the momentary difference in the suffering. It is not to be doubted but that a woman, high-spirited like Cleopatra, was also above the momentary differences in feeling; and had the way in which she died not been ordinary and usual, she certainly would not have applied herself to the invention of a new one. We are therefore to look upon her dying by the bite of the cerastes, as only following the manner of death which she had seen adopted by those who intended to die without torment. Galen, speaking of the aspic in the great city of Alexandria, says, I have seen how speedily they (the aspics) occasioned death. Whenever any person is condemned to die whom they wish to end quickly and without torment, they put the viper to his breast, and suffering him there to creep a little, the man is presently killed. Pausanias speaks of particular serpents that were to be found in Arabia, among the balsam-trees, several of which I procured, both alive and dead, when I brought the tree from Beder unein; but they were still the same species of serpent, only some from sex, and some from want of age, had not the horns, though in every other respect they could not be mistaken. Ibn Sina, called by the Europeans Avicenna, has described this animal very exactly. He says it is frequent in Schem (that is, the country about the south of Damascus), and also in Egypt; and he makes a very good observation on their manners; that they do not go or walk straight, but by contracting themselves; but in the latter part of his description he seems not to have known the serpent he is speaking of, because he says its bite is cured in the same manner as that of the viper and cerastes, by which it is implied that the animal he was describing was not a cerastes, and the cerastes is not a viper, both of which assertions are false.

"A long dissertation," adds Mr. Bruce, "would remain on

the incantation of serpents. There is no doubt of its reality: the scriptures are full of it; all that have been in Egypt have seen as many different instances as they chose. Some have doubted that it was a trick, and that the animals so handled, had been first trained, and then disarmed of their power of hurting; and, fond of the discovery, they have rested themselves upon it, without experiment, in the face of all antiquity. But I will not hesitate to aver, that I have seen at Cairo (and this may be seen daily, without trouble or expence), a man who came from above the catacombs, where the pits of the mummy birds are kept, who has taken a cerastes with his naked hand, from a number of others lying at the bottom of the tub, has put it upon his bare head, covered it with the common red cap he wears, then taken it out, put it in his breast, and tied it about his neck like a necklace; after which it has been applied to a hen, and bit it, which has died in a few minutes; and, to complete the experiment, the man has taken it by the neck, and, beginning at the tail, has ate it, as one would do a carrot or a stock of celery, without any seeming repugnance.

"We know from history, that where any country has been remarkably infested with serpents, there the people have been screened by this secret. The Psylli and Marmarides of old were defended in this manner.

"Ad quorum cantus mites jacuere Cerastæ*.
Sil. Ital. lib. 3.

"To leave ancient history, I can myself avouch, that all the black people in the kingdom of Sennaar, whether Funge or Nuba, are perfectly armed against the bite of either scorpion or viper. They take the Cerastes in their hands at all times, put them in their bosoms, and throw them at one another as children do apples or balls, without having irritated them by this usage so much as to bite. The Arabs have not this secret naturally, but from their infancy they acquire an exemption from the mortal consequences attending the bite of these animals, by chewing a certain root, and washing themselves (it is not anointing) with an infusion of certain plants in water. One day, when I was sitting with the brother of Shekh Adelan, prime minister of Sennaar, a slave of his brought a cerastes, which he had just taken out of a hole, and was using with every sort of familiarity. I told him my suspicion that the teeth

* Tame at whose spell the charm'd cerastes lay.

had been drawn, but he assured me they were not, as did his master Kitton, who took it from him, wound it round his arm, and at my desire ordered the servant to carry it home with me. I took a chicken by the neck, and made it flutter before him; his seeming indifference left him, and he bit it with great signs of anger; the chicken almost died immediately*; I say his seeming indifference, for I constantly observed, that, however lively the viper was before, yet upon being seized by any of these barbarians, he seemed as if taken with sickness, and feebleness, frequently shut his eyes, and never turned his mouth towards the arm of the person that held him. I asked Kitton how they came to be exempted from this mischief? He said they were born so, and so said the grave and respectable men among them. Many of the lighter and lower sort talked of enchantments by words and by writing, but they all knew how to prepare any person by medicines, which were decoctions of herbs and roots. I have seen many thus armed for a season, do pretty much the same feats as those who possessed the exemption naturally; the drugs were given me, and I several times armed myself, as I thought, resolved to try the experiment; but my heart always failed me, when I came to the trial; because among these wretched people it was a pretence they might very probably have sheltered themselves under, that I was a Christian, and that therefore it had no effect upon me. I have still remaining by me a small quantity of this root, but never had an opportunity of trying the experiment."

The cerastes often makes its appearance among the numerous hieroglyphic figures on the various remains of Egyptian antiquity; and is particularly conspicuous on a pair of large sculptured stones brought from Alexandria, and preserved in the British Museum, and which, probably, made a part of the cornice of some magnificent temple.

This animal, like some other poisonous serpents, is supposed to be viviparous.

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* Might not this have happened from the tooth piercing the spinal marrow; and would not the same effect have happened, had the chicken been pierced with a pin?

SECTION XI.

Spectacle or Hooded Snake.

Coluber Naja.—LINN.

THE coluber naja, or cobra de capello, is a native of India, where it appears to be one of the most common, as well as most noxious, of the serpent tribe; very frequently proving fatal, in the space of a few minutes, to those who unfortunately experience its bite. Its remarkable form and colours are such as to distinguish it with great ease from almost every other snake. Its general length seems to be three or four feet, and the diameter of the body about an inch and a quarter: the head is rather small than large, and is covered on the fore part with large smooth scales; resembling, in this respect, the majority of innoxious serpents: the back part, sides, and neck, with smaller ovate scales; and the remainder of the animal, on the upper parts, with small, distinct, oblong-oval scales, not ill resembling the general form of a grain of rice. At a small distance beyond the head is a lateral swelling or dilatation of the skin, which is continued to the distance of about four inches downwards, where the outline gradually sinks into the cylindric form of the rest of the body. This part is extensile, at the pleasure of the animal; and when viewed from above, while in its most extended state, is of a somewhat cordated form, or wider at the upper than the lower part: it is marked above by a very large and conspicuous patch or spot, greatly resembling the figure of a pair of spectacles; the mark itself being white with black edges, and the middle of each of the rounded parts black. This mark is more or less distinct in different individuals, and also varies occasionally in size and form, and in some is even altogether wanting. The usual colour of the animal is a pale ferruginous brown above; the under parts being of a blueish white, sometimes slightly tinged with pale brown, or yellow: the tail, which is of moderate length, tapers gradually, and terminates in a slender, sharp-pointed extremity.

This formidable reptile has obtained its Portuguese title of *Cobra de Capello*, or *hooded snake*, from the appearance which it presents when viewed in front in an irritated state, or when preparing to bite; at which time it bends the head rather downwards, and seems hooded, as it were, in some degree, by the ex-

panded skin of the neck. In India it is every where exhibited publicly as a show, and is, of course, more universally known in that country than almost any other of the race of reptiles. It is carried about in a covered basket, and so managed by its proprietors as to assume, when exhibited, a kind of dancing motion; raising itself up on its lower part, and alternately moving its head and body from side to side for some minutes to the sound of some musical instrument which is played duving the time. The Indian jugglers, who thus exhibit the animal, first deprive it of its fangs, by which means they are secured from the danger of the bite.

Dr. Russel, in his account of experiments made in India with this serpent, observes, that, as a general standard for a comparison of the effect of its bite with that of the other poisonous serpents, he never knew it prove mortal to a dog in less than twenty-seven minutes, and a chicken in less than half a minute. Thus, fatal as it is, its poison seems not so speedy in operation as that of the rattle-snake, which has been known to kill a dog in the space of two minutes.

CHAP. VI.

BIRDS.

Aves.—Linn.

SECTION I.

Condor Gryphus.

Vultur.—Linn.

This is a bird of prodigious size, with a caruncle on the crown as long as the head; throat naked. Inhabits South America; measures, with the wings extended, from tip to tip, not less than from twelve to sixteen feet; builds under the protection of the highest rocks; lays two white eggs. It is a bird of fearful and enormous power, but, happily for mankind, in every country extremely rare. Feuillée has well described a specimen that fell a prey to his own courage.

"I discovered," says he, "in the valley of Ilo, in Peru, a con-

dor perched on a high rock before me; I approached within musket shot, and fired; but as my piece was only loaded with swan-shot, the lead was not able sufficiently to pierce the bird's feathers. I perceived, however, by its manner of flying, that it was wounded; as it rose heavily, and with a good deal of difficulty, reached another rock, about five hundred yards distant, upon the shore; I therefore loaded again with a ball, and hit the bird under the throat, which made it mine. I accordingly ran up to seize it; but even in death it was terrible, and defended itself on its back, with its claws extended against me; so that I scarce knew how to lay hold of it. Had it not been mortally wounded, I should have found it no easy matter to take it; but I at last dragged it down from the rock, and, with the assistance of one of the seamen, carried it to the tent, to make a coloured drawing.

"The wings of this bird, which I measured exactly, were eleven feet four inches, from one extremity to the other: the great feathers, of a beautiful shining black, were two feet two inches long. The thickness of the beak was proportionable to the rest of the body; the length about four inches; the point hooked downwards, and white at its extremity, the other part being of a jet black. A short down, of a brown colour, covered the head; the eyes were black, and surrounded with a circle of reddish brown; the feathers on the breast, neck, and wings, were of a light brown; those on the back rather darker; its thighs were covered with brown feathers down to the knee: the thigh bone was ten inches long; the leg five inches: the toes were three before and one behind: the latter was an inch and a half long, with a single joint; and the claw with which it was armed was black, and three-quarters of an inch; the other claws were in the same proportion; and the leg and toes covered with black scales.

"These birds usually frequent the mountains, where they find their prey. They never descend to the sea shore, but in the rainy season; sensible of cold they repair there for warmth. Though these mountains are situated in the torrid zone, the cold is often very severe; for throughout almost the whole year, they are covered with snow; but especially during the winter, when it is in great depth upon them. The small quantity of nourishment which these birds find on the sea-coast, except when the tempest drives in some of the larger fishes, obliges the condor to remain there but a short time. He usually comes to the coast at the approach of

evening, remains there all night, and returns again in the morning."

This condor, however, seems to have been much inferior in size to those described by Acosta, Garcilasso, Demarchais, and some other travellers, who affirm they have seen them eighteen feet from tip to tip of the wing; that their beaks are so strong and sharp, that they can easily pierce the body of a cow; that two of them can attack and devour one entirely; that they sometimes singly oppose a man. The Indians, in like manner, who are more accustomed to see them, declare, that they can carry off a deer or a calf as easily as an eagle does a rabbit; that their bodies are as large as a sheep; that their flesh is tough, and smells like carrion: their sight piercing, and their looks cruel. The Spaniards themselves seem afraid of their depredations; and are not without instances of their carrying off children of ten or twelve years old. Their flight is terrible; and, when they alight, one is stunned with their noise. Condamine asserts, that he has often seen them in the province of Quito, and on the borders of the Maragnon, swimming over a flock of sheep, some of which they would have carried off, had they not been scared by the shepherds. It is reported that the Indians of these countries catch them, by working a piece of viscous clay into the form of a child, upon which they dart with such rapidity, that their claws are entangled, so as to prevent their escape. De Solis, alluding to this bird, says, that there were among the curiosities of the Emperor of Mexico, birds of such extraordinary fierceness and size, as to appear monsters; and that he had been informed, that each of them could devour a sheep at a single meal.

After reading the history of these birds, the fiction of Virgil's harpies appears less extravagant, or rather seems to sink into mere narrative. Later writers, however, have greatly softened these accounts, and assure us that the countenance of the condor is not so terrible as the first travellers have painted it; and that their nature appears equally mild with that of the eagle, or the vulture.

Mr. Ray, and almost all the naturalists after him, have classed the condor in the genus of the vultures, on account of the nakedness of his head and neck. His dispositions, however, and habits, seem as strongly to plead his affinity to the eagles: he is rapid, fierce, and courageous, and, like them, lives by the chace. His

preferring live prey to carrion, his activity, and every habit, seem to bring him nearer to the eagle than to the vulture tribes.

However this may be, it is probable this extraordinary bird is not confined solely to South America. Some are of opinion, that it is also to be found in Africa, Asia, and even in some parts of Europe. Garcilasso imagines it to be the same bird with the roc, so famous in the fables of the Arabian writers. Probably the great bird mentioned in the voyages to the South Sea, which is said to be nearly as large as an ostrich, is the same with the condor. The bird of prey, in the neighbourhood of Tarnassar, in the East Indies, and the vulture of Senegal, which carries off children, are of the same species with that above described. Several authors mention a similar bird, sometimes seen in Russia, Lapland, and Germany. Buffon mentions a large bird shot in France, eighteen feet in breadth, which he supposes to be the condor, not only on account of its size, but of its pie colour, resembling those birds in Peru. This naturalist deems it scarcely probable, that a bird which claims the first rank in this class of beings, should be confined to a single district of the earth.

[*Ray. Feuillée. Humboldt. Pantologia.*

SECTION II.

Bulbul, or Jocose Shrike.

Lanius jocosus.—Linn.

This bird is of the size of a lark, but varying in different individuals: colour above, brown; beneath, dull white, with the vent pale crimson, or bright rose-colour: crown of the head black, with a rising, finely-fibred crest in the middle: from the corners of the bill on each side, a black stripe; beneath each eye a small bright crimson spot, and across the breast a brown bar. Native of China, India, Persia, &c. and sometimes called by the name of bulbul: of a lively disposition, and agreeable manners. It has been generally considered as the celebrated bulbul, or Persian nightingale, so often commemorated in the works of Hafiz, Sadi, and other Persian poets. This, however, seems not clearly ascertained; and the name bulbul, usually translated nightingale, seems to be applied, in different parts of India and Persia, to very dif-

ferent birds. What appears certain of the present species is, that it is often taught to fight by the natives of Bengal; one being held up opposite to another, on the hand of a man to whose finger the bird is fastened by a string, sufficiently long to enable it to fly and peck at its adversary. It is said to be of a remarkably docile disposition, and is sometimes carried by the young Indians, in order to execute little commissions of gallantry; and at a signal given by the lover, will seize and carry off, with much dexterity, the small gold ornament usually worn on the head of a young Indian lady, and convey it to his master. It will, also, with admirable celerity, follow the descent of a ring purposely thrown down a deep well; catching it in its fall, and returning it to its owner. The Persian poets represent the bulbul as enamoured of the rose, and grieved, or angry at seeing it rudely cropped. Whatever may be said by poets, and unscientific observers, Mr. Pennant has not scrupled to declare his opinion, that the natural note of this bird is harsh and unmelodious. If this be the case, the music of the bulbul may be considered as nearly allied to the celebrated song of the swan, so often recorded in the flights of poetic fiction.

[*Shaw.*

SECTION III.

Humming-bird.

Trochilus.—Linn.

In forming this minute animal, nature appears to have been hesitating whether she would fabricate a bird or an insect. They are the least of the feathered tribe; they feed, like insects on the nectar of flowers, particularly those with long tubes, which they extract, like bees, while on the wing, fluttering about the place, and making a humming noise: the legs and bill are very weak; the tail feathers are ten.

Of all animated beings, the humming-bird is perhaps the most elegant in form, and brilliant in its colours. Activity, rapidity, and richness of drapery, sometimes sparingly bestowed by nature on the other tenants of the air, she has heaped upon the humming-bird without measure. The emerald, ruby, and topaz sparkle on its apparel, which is never soiled by the dust, for in its aerial life it scarcely ever descends so low as to touch the grass. It flies

from flower to flower, extracting their quintessence alone; and never quits a climate where perpetual spring renews without ceasing the delicious luxuries on which it banquets. It is seldom that the humming-bird retires from the intratropical regions; appearing successively to advance and recede with the sun on either side of the line, in pursuit of an uninterrupted summer.

The Indians, struck with the lustre and fire of its plumage, call it the sun-beam; and the Spaniards tomino, from its minute weight. The tongue resembles the section of a silken thread, and the bill has the appearance of a fine needle. The little eyes appear like sparks of a diamond, and the feathers of the wings are so delicate, as to look transparent.

The feet of this creature are so small, that they are scarcely perceptible. He uses them, indeed, but little; for he is continually employed in a humming and rapid flutter, in which the agitation of his wings are so quick, that they are altogether invisible. Like an inconstant lover, he hastens from flower to flower, to gratify his desires and multiply his enjoyments.

The courage and vivacity of these birds are nevertheless surprising. They pursue, with a furious audacity, birds twenty times their size; fasten themselves upon their body, and allow themselves to be carried away by their flight; while they are, in the mean while, pecking them with redoubled strokes of their bill, till their little wrath is appeased. They are solitary till the pairing season, when they engage busily, by pairs, in constructing with moss, lined with the down of the great mullein, a small, round, elegant nest, corresponding with the delicacy of their body. It is the female that completes this cradle for her progeny, while the male charges himself with the task of bringing the materials, which are ingeniously knit into the consistency of a thick and soft piece of cloth. The whole fabric is attached to two leaves, or a single twig, of the citron or orange-tree. It is soon plenished with two small white eggs, of the size of a pea, which the male and female hatch by turns, for twelve days. After this period, the young make their appearance; but it is impossible to say with what nourishment their mother supplies them, unless it be with the moisture which they suck from her tongue, while yet humid with the juice of flowers.

There is no possibility of taming birds so tender. No food could be had by human industry, sufficiently delicate to supply

the place of the nectar which they gather in their wild state. Some have been kept alive for a few weeks, by syrups; but this nourishment, fine as it may seem, must be gross, when compared with what is commonly gathered by these little flutterers among the flowers. Buffon thinks that honey would have proved a better substitute for their ordinary food.

These little birds are neither shy nor suspicious. They allow themselves to be approached within five or six steps, and thus fall an easy prey to the Indians, who catch them by the artifice of a twig covered with lime, and held out near the flower about which they are fluttering. When taken they instantly expire; and after their death are worn as ear-rings by the young Indian ladies. The Peruvians had at one time the art of composing paintings of their feathers, of very great elegance and lustre.

The smallest species of the whole genus is called emphatically *trochilus minimus*, or *least humming-bird.* This is smaller than several of our bees; being scarcely a quarter of an inch in length. Some of them do not weigh more than twenty grains; and none of them more than about forty-five.

[*Pantologia.*

SECTION IV.

Parrot.

Psittacus.—Linn.

This is a numerous kind, and includes the common parrot, cockatoos, lories, paroquets, and maccaws.

Of all foreign birds, this genus is the best known in Europe: from its docility, and the beauty of its plumage, it has been imported in great numbers, and in those countries where it is indigenous, it is the most numerous of all the feathered tribes. The parrot is an intratropical bird, and is found from twenty-four to twenty-five degrees on either side of the equator. Although it lives in the temperate climates of Europe, yet it does not frequently breed there; and its spirits and longevity are diminished in a temperature so little suited to the warmth of its constitution. Parrots are so various in size, and in the shades and distributions of their colours, that it is utterly impossible for language to follow these countless gradations; and the task, though it could be accomplished, would neither prove instructive nor entertaining.

It is remarkable, that of the different species of parrots that are known and described, there is not one common to the New and the Old World. Something like this is observable also in the case of quadrupeds; none of those belonging to the tropical regions in the one continent being discoverable in the same latitudes of the other. No animal that is incapable of bearing the rigours of cold is found to pass from the Old to the New World, because it is only in the regions of the north that these are ascertained to approximate. Notwithstanding its attribute of flight, the parrot is incapable of traversing that vast space which lies between Africa and the East Indies; and all the different tribes of this large class remain confined to their primitive stations on each hemisphere. So short and heavy indeed are their flights, that they can hardly cross an arm of the sea seven or eight leagues broad; hence, almost every island in the West Indies is distinguished by a race of parrots peculiar to itself.

Man has always most admired those animals that seemed to participate most largely of his own nature. The monkey, by its resemblance to his external form, and the parrot by imitating his voice, have excited his wonder, and been deemed a peculiar and privileged race, destined to fill up the intermediate space between him and the brute creation. Savages, who are in general so insensible to the grand spectacle of nature, have viewed these animals with astonishment and delight. They stop their canoes for hours together, to behold the gesticulations of the monkey; and they take such pleasure in taming and educating parrots, that they are said by Buffon to possess the secret of enriching and varying the hue of their plumage; an art to which the more civilized nations of Europe are still strangers.

The Greeks at first knew only one species of parrot, which was imported from the East by one of the captains of Alexander's fleet. Aristotle, the father of naturalists, speaks of it as a rare bird, of which he had only heard by report. The beauty of parrots, and their faculty of speech, soon made them objects of high request among the luxurious Romans, whom the virtuous Cato justly reproaches for this puerile attachment. In his time, they kept them in cages of silver and of ivory, and bought them at a price as high as that of a slave. Till the time of Nero, however, they knew no other species than the Indian; when those who ministered to the pleasure of that extravagant and luxurious emperor, found them in an island far up the river Nile, called Gaganda.

The Portuguese, who first doubled the Cape of Good Hope, found all the coast of Africa, and the islands of the Indian ocean, peopled with various tribes of parrots totally unknown in Europe, and in such vast numbers, that it was with difficulty they could be prevented from devouring the rice and maize. These, however, were far inferior to the numbers and variety that presented themselves to the first adventurers in the New World: some of the islands there were called the Parrot Isles, from the prodigious quantity of these birds which flocked upon them. They constituted the first article of commerce, between the inhabitants of the Old and New Continents. In these regions every forest swarms with them; and the rook is not better known in Europe than the parrot in the East and West Indies.

The genus of parrots, which comprehends such infinite varieties, may easily be discriminated from every other tribe by the formation of the bill. The upper mandible, as well as the lower, in the whole race is moveable. It is not connected, and in one piece with the skull, as in most other birds, but is joined to the head by a strong membrane on each side, that lifts and depresses it at pleasure. By this contrivance, the bird can open its bill wider than it could otherwise do, and thus receive large nuts and fruits, which it can break with great facility.

The toes of parrots display also a peculiar conformation: when walking, two are placed before, and one behind; but when employed to carry food to the bill, one of the back toes is occasionally brought forward. Both the beak and claws of the parrot are used in climbing, an exercise in which the animal appears singularly awkward: the tongue somewhat resembles that of a man; and it is from this circumstance, that some alledge it is so well qualified to imitate the human speech. The formation of the throat, however, and the cavity of the beak, all contribute to its articulation, and to confer on it this distinguished privilege.

Parrots in their wild state feed on almost every kind of fruit and grain. Their flesh, it is said, always contracts the peculiar taste and flavour of the food they eat. At the season when the guava is ripe they are fat and tender, and some of the small tribes of the parrakeet are then sought after by the savages as delicate food. If they feed upon the seeds of the acajou, their flesh acquires the flavour of garlic; when fed upon the seeds of the spicy trees, their flesh tastes of cloves and cinnamon. The seed of the cotton

tree intoxicates them, as well as wine and the smoke of tobacco, which in taming, are often employed, to soften their fierceness and render them more talkative. Their appetite for flesh is unnatural, and when gratified, never fails to bring on diseases. Of all foods, they are fondest of the carthamus or bastard saffron; which, though of a strongly purgative quality to man, agrees perfectly with their constitution, and will fatten the Guinea parrot very quickly.

Birds of this tribe are subject to disorders unknown to the rest of the feathered tribes; many of them die of the epilepsy and the gout. They are, however, remarkable for longevity; and there are some well-attested instances of their having lived from fifty to sixty years. From twenty to thirty years, however, may be considered as the common period which these birds live, when well kept: after which time the bill becomes generally so much hooked, that they are deprived of the power of taking food. They commonly breed in the hollow parts of old trees which have begun to rot, without forming a nest; and sometimes availing themselves of the labour of the woodpecker, they seize upon the hole which it has industriously scooped out. The larger kinds lay only two eggs, but they bring forth twice a year. The smaller kinds, which from their weakness are more exposed to devastation, are probably more prolific; for nature constantly replenishes those species which are most easily destroyed, by conferring upon them a superior degree of fecundity.

As it is only when the parrots are taken young that they can be successfully tamed, the savages commonly take them while in the nest. They sometimes, however, catch them when full grown, for food, and for their feathers, which they convert into valuable articles of dress. For this purpose, they have various contrivances. They sometimes mark the trees upon which they perch, and during night bring sulphurous substances, which they burn around them, and by the fumes of which the birds are suffocated, and fall to the ground. In some places they stun them with arrows wrapped at the point with cotton; in others, they cut down the tree in which the nest is built. In New Spain, where the feather constitutes an article of regular commerce among the natives, they take possession of a number of trees where the parrots breed, and which they transmit as an inheritance from father to son.

The largest species are the maccaws; and when these parrots were first brought into Europe, their beautiful plumage and their large and majestic form created universal admiration. Aldrovandus first

saw one of them at Mantua, in 1572; and he observes, that they were at that time in all the estimation which rarity could give them. Princes gave and received them as the most valuable presents.

Columbus in his second voyage saw several of them as he touched at Guadaloupe. They are to be met with even on the desert islands; and they every where constitute the most beautiful ornament of those gloomy forests that darken the face of a country abandoned by men. While Anson and his officers were contemplating the grand scenes displayed by nature in these solitary abodes, a flight of maccaws passed above them; and, as if to heighten the magnificence of the spectacle, they made several windings through the air, displaying the vivid lustre of their plumage. There are four different species of the maccaw described by naturalists; the red, the blue, the green, and the black. The characters which distinguish them from the other families of this genus are, first, their size, which is nearly double that of any other species; and next, the length of the tail, which seems beyond even the proportion of their bodies; and lastly, the naked skin, of a dirty white, that covers their cheeks and the under parts of their head.

The red and blue maccaw is nearly three feet in length; the whole body, except the wings, is of a vermilion colour; the larger feathers of the wing are of a deep blue on the outside; on the inner, of a brown leather colour: the lesser feathers are of a blue and green, admirably blended together. The greater coverts of the wings are of a golden yellow terminating in green. On the first discovery of America, these birds, as indeed almost every other kind, were so remarkably tame, that they could almost be taken with the hand. The noise of a fowling piece did not much terrify them. This was also the case in the woods of New Zealand, when visited by Captain Cooke, where the birds suffered the approach of man with a kind of confidence and familiarity. The savages, few in number, and badly armed, had scarcely made them feel the dominion of the human race.

Birds of this species are found over all the southern parts of America, and the West Indies. They prefer moist and watery grounds, because in such the palm trees are most frequent, of the fruit of which they are passionately fond. They commonly go in pairs, seldom in flocks; sometimes, however, they assemble in the morning in much greater numbers, when they set up a loud and disagreeable chattering, which is heard at a great distance. They cry while on

the wing, as well as when they perch. Though excellent flyers, they seldom remove far from the place of their abode, except in quest of food; and, when that is obtained, they regularly return in the evening. There is a certain poisonous kind of fruit which they sometimes eat, that is said to communicate its noxious qualities to their flesh, and to render it dangerous to eat them. In Guiana and Brazil, where they are not obliged to take this species of food, they are eat by the natives with great safety.

All the aras, or large parrots, build their nests in the hollow of rotten trees, which, in their native country, are easily to be found: for, there, a much greater number of trees fall merely from age than by the hands of the carpenter. When the tree is not fully rotten, and the hole not large enough for their reception, they widen it with their bills. The last process in finishing their house is the lining it with feathers.

The maccaw lays twice in the year, and generally two eggs at a time, about the size of a pigeon's.

The male and female maccaw share alternately in the labours of incubation, and rearing the young. They are equally assiduous in procuring them food; and, during the whole time of their nonage, the nuptial tie remains unbroken, both parents guarding their offspring with unremitting care.

Maccaws, when young, are easily tamed, and therefore, in many parts of America, they are only caught at that age; because those who catch them are sensible, that all their labour in their education would, after such period, prove fruitless. Du Tertre mentions, however, a singular method of taking the old ones alive practised in the West Indies. The inhabitants watch the moment when they alight to eat the fruit that has fallen; they then surround them, and by clapping their hands and uttering loud shrieks, so alarm them, that, forgetting the use of their wings, they tumble upon their backs to defend themselves by their claws and beak. In the moment of surprise, the savages present to them a stick, which they seize with their claws, when they immediately lay hold of them. These facts, to say no more, appear suspicious; because it is certain these birds fly at the sight of a man; and if so, they will not certainly lie down to listen to his cries.

Another author affirms, that the Indians of the Isthmus of Panama tame maccaws as we tame pies, by allowing them some liberty by day, certain that they will return at night. But however

good domestics, they are not adepts in speaking. The savages adorn themselves with their feathers, by drawing them through the cartilage of the nose. Of all game, these birds are most frequent. They make excellent soup, and are very frequently eat in Cayenne.

This species, perhaps, more than any other of the feathered race, is subject to epilepsy; a disorder which is more violent and fatal in warm than in temperate climes. The savages pretend to have found out a cure for this disease, which consists in cutting off the extremity of one of the bird's toes, and allowing the blood to flow.

To this disease the parrots that are kept in a domesticated state are more subject than the wild. The abstraction of the female, the superabundance of food, and the consequent excess of blood in the system, seem to be the causes of epilepsy among these birds. [*Phil. Trans. Pantolog.*

SECTION V.

Woodpecker.

Picus.—Linn.

The birds of this genus climb up and down trees in search of insects, which they transfix and draw out from the clefts of the bark by means of the tongue, which is long at the end, barbed, and furnished with a curious apparatus of muscles, for the purpose of throwing it forward with great force. The life of the woodpecker appears therefore to be hardier and less pleasurable than that of most birds. Condemned to this painful toil, he can obtain no food but by boring the bark and hard fibres of trees that inclose it. Thus continually occupied, he enjoys neither relaxation nor rest; and often sleeps in the constrained attitude in which he spent the day. He shares in none of the agreeable sports of the rest of the tenants of the air; he enters into none of their concerts; he utters only savage cries, or plaintive accents, which interrupt the silence of the forest, and express the efforts of a life of fatigue and of pain. The manners of this bird are suited to its condition: its air is disconsolate; the traits of its visage harsh. The dispositions of the woodpecker are wild and savage. He flies from society, even that of his mate; and when forced by the impulse of sexual appetite to seek a companion, he does it without that graceful address, with which this passion animates creatures of more sensibility.

Such are the condition and habits of the woodpecker. Nature, however, amidst her unkindness, has not denied him instruments

suited to his destiny. His legs are strong and muscular; and the disposition of his toes, of which two are before, and two backward, is fitted for a vigorous adhesion to the trunks of trees where his work lies. His bill, square at the base, but flattened laterally towards the top, like a pair of scissars, is the instrument by which he cuts the trunks of trees, where the insects deposit their eggs. From his bill he darts out his long, round tongue, armed at the top with a short bony substance, like a needle; and with this instrument he stabs and draws out the small worms found in the timber. His nest is constructed of the raspings of the wood, in the cavity which he has dug; and it is from the heart of the tree that the progeny issues, which is destined to creep around and gnaw it down.

The genus comprises fifty-eight species, scattered over the globe, but chiefly inhabitants of America; five or six are natives of own country.

One of the largest is the great black woodpecker, (*picus martius*), found in Europe generally, as also in Chili; resides chiefly among poplar trees; builds a large and deep nest, and lays from two to three white eggs; feeds principally on bees and ants; from seventeen to eighteen inches long. In the female the hind-head only is red.

These birds strike with such force against the trees which they excavate, that their noise is heard as far as that of a wood-cutter's hatchet. They sometimes make a large cavity in the interior part of a tree, which weakens it so much, that it falls with the first gale of wind: and hence they often occasion considerable damage to the proprietors of woods.

The bird frequently employs this cavity for a nest: which it makes large and commodious, which may be judged from the heaps of broken chips, which are seen at the foot of the tree which has been thus hollowed out. Aristotle asserts, that none of the woodpeckers ever alight upon the ground; and it must be admitted, that they are seldom seen there. In winter, birds of this species regularly disappear; the ants and insects penetrating, in these colder months, into the wood so deeply, that they cannot easily be dug out.

[*Pantologia.*

SECTION VI.

Cuckoo.

Cuculus.—LINN.

THE first appearance of cuckoos in Gloucestershire, the part of England where these observations were made, is about the 17th of April. The song of the male, which is well known, soon proclaims its arrival. The songs of the female, if the peculiar notes of which it is composed may be so called, is widely different, and has been so little attended to, that I believe few are acquainted with it. I know not how to convey a proper idea of it by a comparison with the notes of any other bird; but the cry of the dab-chick bears the nearest resemblance to it.

Unlike the generality of birds, cuckoos do not pair. When a female appears on the wing, she is often attended by two or three males, who seem to be earnestly contending for her favours. From the time of her appearance, till after the middle of summer, nests of birds selected to receive her egg are to be found in great abundance; but like the other migrating birds, she does not begin to lay till some weeks after her arrival. I never could procure an egg till the middle of May, though probably an early-coming cuckoo may produce one sooner*.

The cuckoo makes choice of the nests of a great variety of small birds. I have known its egg entrusted to the care of the hedge-sparrow, the water-wagtail, the titlark, the yellow-hammer, the green-linnet, and the winchat. Among these it generally selects the three former; but shews a much greater partiality to the hedge-sparrow than to any of the rest: therefore, for the purpose of avoiding confusion, this bird only, in the following account, will be considered as the foster-parent of the cuckoo, except in instances which are particularly specified.

The hedge-sparrow commonly takes up four or five days in laying her eggs. During this time, generally after she has laid one or two, the cuckoo contrives to deposit her egg among the rest, leav-

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* What is meant by an early-coming cuckoo, I shall more fully explain in a paper on the migration of birds, but it may be necessary to mention here, that migrating birds of the same species arrive and depart in succession. Cuckoos, for example, appear in greater numbers on the 2d than on the 1st week of their arrival, and they disappear in the same gradual manner.—ORIG.

ing the future care of it entirely to the hedge-sparrow. This intrusion often occasions some discomposure; for the old hedge-sparrow at intervals, while she is sitting, not unfrequently throws out some of her own eggs, and sometimes injures them in such a way that they become addle; so that it more frequently happens, that only two or three hedge-sparrow's eggs are hatched with the cuckoo's, than otherwise; but whether this be the case or not, she sits the same length of time as if no foreign egg had been introduced, the cuckoo's egg requiring no longer incubation than her own. However, I have never seen an instance where the hedge-sparrow has either thrown out or injured the egg of the cuckoo. When the hedge-sparrow has sat her usual time, and disengaged the young cuckoo and some of her own offspring from the shell*, her young ones, and any of her eggs that remain unhatched, are soon turned out, the young cuckoo remaining possessor of the nest, and sole object of her future care. The young birds are not previously killed, nor are the eggs demolished; but all are left to perish together, either entangled about the bush which contains the nest, or lying on the ground under it.

The early fate of the young hedge-sparrows is a circumstance that has been noticed by others, but attributed to wrong causes. A variety of conjectures have been formed upon it. Some have supposed the parent cuckoo the author of their destruction; while others, as erroneously, have pronounced them smothered by the disproportioned size of their fellow-nestling. Now the cuckoo's egg being not much larger than the hedge-sparrow's, it necessarily follows, that at first there can be no great difference in the size of the birds just burst from the shell. Of the fallacy of the former assertion also I was some years ago convinced, by having found that many cuckoo's eggs were hatched in the nests of other birds, after the old cuckoo had disappeared; and by seeing the same fate then attend the nestling sparrows as during the appearance of old cuckoos in this country.

Having found that the old hedge-sparrow commonly throws out some of her own eggs after her nest has received the cuckoo's, and not knowing how she might treat her young ones, if the young cuckoo was deprived of the power of dispossessing them of the nest, I made the following experiment. July 9. A young cuckoo,

* The young cuckoo is commonly hatched first.—Orig.

that had been hatched by a hedge-sparrow about four hours, was confined in the nest in such a manner that it could not possibly turn out the young hedge-sparrows which were hatched at the same time, though it was almost incessantly making attempts to effect it. The consequence was, the old birds fed the whole alike, and appeared in every respect to pay the same attention to their own young as to the young cuckoo, till the 13th, when the nest was unfortunately plundered.

The smallness of the cuckoo's egg, in proportion to the size of the bird, is a circumstance that hitherto I believe has escaped the notice of the ornithologist. So great is the disproportion, that it is in general smaller than that of the house-sparrow; whereas the difference in the size of the birds is nearly five to one. I have used the term in general, because eggs produced at different times by the same bird vary much in size. I found a cuckoo's egg so light that it weighed only 43 grs., and one so heavy that it weighed 55 grs. The colour of the cuckoo's egg is extremely variable. Some, both in ground and penciling, very much resemble the house-sparrow's; some are indistinctly covered with bran-coloured spots; and others are marked with lines of black, resembling in some measure the eggs of the yellow-hammer.

The circumstance of the young cuckoo's being destined by nature to throw out the young hedge-sparrows, seems to account for the parent-cuckoo's dropping her egg in the nests of birds so small as those I have particularized. If she were to do this in the nest of a bird which produced a large egg, and consequently a large nestling, the young cuckoo would probably find an insurmountable difficulty in solely possessing the nest, as its exertion would be unequal to the labour of turning out the young birds*. Besides, though many of the larger birds might have fed the nestling cuckoo very properly, had it been committed to their charge, yet they could not have suffered their own young to have been sacri-

* I have known an instance in which a hedge-sparrow sat on a cuckoo's egg and one of her own. Her own egg was hatched five days before the cuckoo's, when the young hedge-sparrow had gained such a superiority in size, that the young cuckoo had not power sufficient to lift it out of the nest till it was two days old, by which time it was grown very considerably. This egg was probably laid by the cuckoo several days after the hedge-sparrow had begun to sit; and even in this case it appears that its presence had created the disurbance before alluded to, as all the hedge-sparrow's eggs were gone except one. —ORIG.

ficed for the accommodation of the cuckoo in such great number as the smaller ones, which are so much more abundant; for though it would be a vain attempt to calculate the numbers of nestlings destroyed by means of the cuckoo, yet the slightest observation would be sufficient to convince us that they must be very large. Here it may be remarked, that though nature permits the young cuckoo to make this great waste, yet the animals thus destroyed are not thrown away, or rendered useless. At the season when this happens, great numbers of tender quadrupeds and reptiles are seeking provisions; and if they find the callow nestlings which have fallen victims to the young cuckoo, they are furnished with food well adapted to their peculiar state.

It appears a little extraordinary, that two cuckoo's eggs should ever be deposited in the same nest, as the young one produced from one of them must inevitably perish; yet I have known two instances of this kind, one of which I shall relate. June 27, 1787, two cuckoos and a hedge sparrow were hatched in the same nest this morning; one hedge-sparrow's egg remained unhatched. In a few hours after, a contest began between the cuckoos for the possession of the nest, which continued undetermined till the next afternoon; when one of them, which was somewhat superior in size, turned out the other, together with the hedge-sparrow and the unhatched egg. This contest was very remarkable. The combatants alternately appeared to have the advantage, as each carried the other several times nearly to the top of the nest, and then sunk down again, oppressed by the weight of its burden; till at length, after various efforts, the strongest prevailed, and was afterwards brought up by the hedge-sparrows.

I come now, to consider the principal matter that has agitated the mind of the naturalist respecting the cuckoo; why, like other birds, it should not build a nest, incubate its eggs, and rear its own young? There is certainly no reason to be assigned, from the conformation of this bird, why, in common with others, it should not perform all these several offices: for it is in every respect perfectly formed for collecting materials and building a nest. Neither its external shape nor internal structure prevent it from incubation; nor is it by any means incapacitated from bringing food to its young. It would be needless to enumerate the various opinions of authors on this subject, from Aristotle to the present time. Those of the ancient appear to be either visionary,

or erroneous; and the attempts of the moderns towards its investigation have been confined within very narrow limits; for they have gone but little farther in their researches than to examine the constitution and the structure of the bird, and having found it possessed a capacious stomach with a thin external covering, concluded that the pressure on this part, in a sitting posture, prevented incubation. They have not considered that many of the birds which incubate, have stomachs analogous to those of cuckoos: the stomach of the owl, for example, is proportionably capacious, and is almost as thinly covered with external integuments. Nor have they considered that the stomachs of nestlings are always much distended with food; and that this very part, during the whole time of their confinement to the nest, supports, in a great degree, the weight of the whole body; whereas, in a sitting bird, it is not nearly so much pressed on; for the breast in that case fills up chiefly the cavity of the nest, for which purpose, from its natural convexity, it is admirably well fitted.

These observations, I presume, may be sufficient to shew that the cuckoo is not rendered incapable of sitting, through a peculiarity either in the situation or formation of the stomach; yet, as a proof still more decisive, I shall state the following fact. In the summer of the year 1786, I saw, in the nest of the hedge-sparrow, a cuckoo, which, from its size and plumage, appeared to be nearly a fortnight old. On lifting it up in the nest, I observed two hedge-sparrow's eggs under it. At first I supposed them part of the number which had been sat on by the hedge-sparrow with the cuckoo's egg, and that they had become addle, as birds frequently suffer such eggs to remain in their nests with their young; but on breaking one of them I found it contained a living fœtus; so that of course these eggs must have been laid several days after the cuckoo was hatched, as the latter now completely filled up the nest, and was by this peculiar incident performing the part of a sitting-bird*.

Having under my inspection, in another hedge-sparrow's nest, a cuckoo, about the same size as the former, I procured two wagtail's eggs which had been sat on a few days, and had them

* At this time I was unacquainted with the fact, that the young cuckoo turned out the eggs of the hedge-sparrow; but it is reasonable to conclude, that it had lost the disposition for doing this when these eggs were deposited in the nest.—Orig.

immediately conveyed to the spot, and placed under the cuckoo. On the 9th day after the eggs had been in this situation, the person appointed to superintend the nest, as it was some distance from the place of my residence, came to inform me, that the wagtails were hatched. On going to the place, and examining the nest, I found nothing in it but the cuckoo and the shells of the wagtail's eggs. The fact therefore of the birds being hatched, I do not give as coming immediately under my own eye; but the testimony of the person appointed to watch the nest was corroborated by that of another witness.

To what cause then may we attribute the singularities of the cuckoo? May they not be owing to the following circumstances? The short residence this bird is allowed to make in this country, where it is destined to propagate its species, and the call that nature has on it, during that short residence, to produce a numerous progeny. The cuckoo's first appearance here is about the middle of April, commonly on the 17th. Its egg is not ready for incubation till some weeks after its arrival, seldom before the middle of May. A fortnight is taken up by the sitting bird in hatching the egg. The young bird generally continues three weeks in the nest before it flies, and the foster-parents feed it more than five weeks after this period; so that, if a cuckoo should be ready with an egg much sooner than the time pointed out, not a single nestling, even one of the earliest, would be fit to provide for itself before its parent would be instinctively directed to seek a new residence, and be thus compelled to abandon its young one; for old cuckoos take their final leave of this country the first week in July.

Had nature allowed the cuckoo to have staid here as long as some other migrating birds, which produce a single set of young ones, as the swift or nightingale for example, and had allowed her to have reared as large a number as any bird is capable of bringing up at one time, these might not have been sufficient to have answered her purpose; but by sending the cuckoo from one nest to another, she is reduced to the same state as the bird whose nest we daily rob of an egg, in which case the stimulus for incubation is suspended. Of this we have a familiar example in the common domestic fowl. That the cuckoo actually lays a great number of eggs, dissection seems to prove very decisively.

Among the many peculiarities of the young cuckoo, there is one

that shows itself very early. Long before it leaves the nest, it frequently, when irritated, assumes the manner of a bird of prey, looks ferocious, throws itself back, and pecks at any thing presented to it with great vehemence, often at the same time making a chuckling noise like a young hawk. Sometimes, when disturbed in a smaller degree, it makes a kind of hissing noise, accompanied with a heaving motion of the whole body*. The growth of the young cuckoo is uncommonly rapid. The chirp is plaintive, like that of the hedge-sparrow; but the sound is not acquired from the foster-parent, as it is the same whether it be reared by the hedge-sparrow, or any other bird. It never acquires the adult note during its stay in this country.

The stomachs of young cuckoos contain a great variety of food. On dissecting one that was brought up by wagtails, and fed by them at the time it was shot, though it was nearly of the size and fulness of plumage of the parent-bird, I found in its stomach the following substances. Flies and beetles of various kinds: small snails, with their shells unbroken; grasshoppers; caterpillars; part of a horse-bean; a vegetable substance, resembling bits of tough grass, rolled into a ball; the seeds of a vegetable that resembled those of the goose grass.

In the stomach of one fed by hedge-sparrows, the contents were almost entirely vegetable; such as wheat, small vetches, &c. But this was the only instance of the kind I had ever seen, as these birds in general feed the young cuckoo with scarcely any thing but animal food. However, it served to clear up a point which before had somewhat puzzled me; for having found the cuckoo's egg in the nest of a green linnet, which begins very early to feed its young with vegetable food, I was apprehensive, till I saw the fact, that this bird would have been an unfit foster-parent for the young cuckoo. The titlark, I observed, feeds it principally with grasshoppers. But the most singular subtance, so often met with in the stomachs of young cuckoos, is a ball of hair curiously wound up. I have found

* Young animals being deprived of other modes of defence, are probably endowed with the power of exciting fear in their common enemies. If you but slightly touch the young hedge-hog, for instance, before it becomes fully armed with its prickly coat, the little animal jumps up with a sudden spring, and imitates very closely the sound of the word, hush! as we pronounce it in a loud whisper. This disposition is apparent in many other animals.—ORIG.

it of various sizes, from that of a pea to that of a small nutmeg. It seems to be composed chiefly of horse-hairs, and from the resemblance it bears to the inside covering of the nest, I conceive the bird swallows it while a nestling. In the stomachs of old cuckoos, I have often seen masses of hair; but these had evidently once formed a part of the hairy caterpillar, which the cuckoo often takes for its food.

There seems to be no precise time fixed for the departure of young cuckoos. I believe they go off in succession, probably as soon as they are capable of taking care of themselves; for though they stay here till they become nearly equal in size and growth of plumage to the old cuckoo, yet in this very state the fostering care of the hedge-sparrow is not withdrawn from them. I have frequently seen the young cuckow of such a size, that the hedge-sparrow has perched on its back, or half-expanded wing, in order to gain sufficient elevation to put the food into its mouth. At this advanced stage, I believe that young cuckoos procure some food for themselves: like the young rook, for instance, which in part feeds itself, and is partly fed by the old ones till the approach of the pairing season. If they did not go off in succession, it is probable we should see them in larger numbers by the middle of August; for, as they are to be found in great plenty*, when in a nestling state, they must now appear very numerous, since all of them must have quitted the nest before this time. But this is not the case; for they are not more numerous at any season than the parent birds are in the months of May and June.

The same instinctive impulse which directs the cuckoo to deposit her eggs in the nests of other birds, directs her young ones to throw out the eggs and young of the owner of the nest. The scheme of nature would be incomplete without it; for it would be extremely difficult, if not impossible, for the little birds, destined to find succour for the cuckoo, to find it also for their own young ones, after a certain period: nor would there be room for the whole to inhabit the nest. *Phil. Trans. Abr. vol.* x.

The following observations of Dr. Darwin, however should seem to disprove the general doctrine, that the cuckoo never builds a nest, incubates its eggs, or rears its young.

* I have known four young cuckoos in the nests of hedge-sparrows, in a small paddock, at the same time.—ORIG.

"The cuckoo," says he, "in some parts of England, as I am well informed by a very distinct and ingenious gentleman, hatches and educates her young; whilst in other parts she builds no nest, but uses that of some lesser bird, generally either of the wagtail or hedge-sparrow, and depositing one egg in it, takes no further care of her progeny.

M. Herissant thought, that he had discovered the reason why cuckoos do not incubate their own eggs, by having observed that the crop or stomach of the cuckoo was placed behind the sternum, or breast-bone, and he thence fancied, that this would render incubation disagreeable or impracticable. Hist. de l'Acad. Royal. 1752. But Mr. White, in his Natural History of Selbourn asserts, that on dissecting a fern-owl he found the situation of the crop or stomach of that bird to be behind the sternum, like that of the cuckoo, and supposes that many other birds may be organized in the same manner. And, as the fern-owl incubates and hatches her own eggs, he rationally concludes, that this structure of the bird cannot be the cause of her want of maternal storge.

As the Rev. Mr. Stafford was walking in Glosop Dale, in the Peak of Derbyshire, he saw a cuckoo rise from its nest. The nest was on the stump of a tree, that had been some time felled, among some chips that were in part turned grey, so as much to resemble the colour of the bird; in this nest were two young cuckoos: tying a string about the leg of one of them, he pegged the other end of it to the ground, and very frequently for many days beheld the old cuckoo feed these young, as he stood very near them.

The following extract of a letter from the Rev. Mr. Wilmot, of Morley, near Derby, strengthens the truth of the fact above mentioned, of the cuckoo sometimes making a nest, and hatching her own young.

In the beginning of July, 1792, I was attending some labourers on my farm, when one of them said to me, "There is a bird's nest upon one of the Coal-slack Hills; the bird is now sitting, and is exactly like a cuckoo. They say that cuckoos never hatch their own eggs, otherwise I should have sworn it was one." He took me to the spot, it was an open fallow ground; the bird was upon the nest, I stood and observed her some time, and was perfectly satisfied it was a cuckoo; I then put my hand towards her, and she almost let me touch her before she rose from the nest, which she apeared to quit with great uneasiness, skimming over the

ground in the manner that a hen partridge does when disturbed from a new hatched brood, and went only to a thicket about forty or fifty yards from the nest; and continued there as long as I staid to observe her, which was not many minutes. In the nest, which was barely a hole scratched out of the coal slack in the manner of a plover's nest, I observed three eggs, but did not touch them. As I had labourers constantly at work in that field, I went thither every day, and always looked to see if the bird was there, but did not disturb her for seven or eight days, when I was tempted to drive her from the nest, and found two young ones, that appeared to have been hatched some days, but there was no appearance of the third egg. I then mentioned this extraordinary circumstance (for such I thought it) to Mr. and Mrs. Holyoak of Bidford Grange, Warwickshire, and to Miss M. Willes, who were on a visit at my house, and who all went to see it. Very lately I reminded Mr. Holyoak of it, who told me he had a perfect recollection of the whole, and that, considering it a curiosity, he walked to look at it several times, was perfectly satisfied as to its being a cuckoo, and thought her more attentive to her young, than any other bird he ever observed, having always found her brooding her young. In about a week after I first saw the young ones, one of them was missing, and I rather suspected my plough-boys having taken it; though it might possibly have been taken by a hawk, sometime when the old one was seeking food. I never found her off her nest but once, and that was the last time I saw the remaining young one, when it was almost full feathered. I then went from home for two or three days, and when I returned, the young one was gone, which I take for granted had flown. Though during this time I frequently saw cuckoos in the thicket I mention, I never observed any one, that I supposed to be the cock-bird, paired with this hen."

Nor is this a new observation, though, it is entirely overlooked by the modern naturalists, for Aristotle speaking of the cuckoo, asserts that she sometimes builds her nest among broken rocks, and on high mountains, but adds in another place that she generally possessed the nest of another bird; and Niphus says that cuckoos rarely build for themselves, most frequently laying their eggs in the nests of other birds.

Zoonomia, Sect. xvi. xiii. 5.

Engraved by Livey from a Drawing by Craig

For the Gallery of Nature & Art.

HUNTING THE OSTRICH.

The fair induction appears to be, that the same instinct which prompts the cuckoo to provide herself with a nest, and, wherever it is attainable, through the labour of some other bird, prompts her, where this is not attainable, to build and incubate for herself. We hear of numerous instances of a similar adaptation. Thus the ostrich, in the desert of Arabia, abandons her eggs after she has deposited them in the sand, and entrusts them to the heat of the sun, which is sufficient for their maturity: but in Senegal, where the heat is somewhat less, and not perfectly adequate, she sits upon them through the night, though she relinquishes them in the day; and at the Cape of Good Hope, where there is less heat still, she sits upon them, like other birds, both day and night.

[*Editor.*

SECTION VII.

Ostrich. Emen or Cassowary.

Struthio.—LINN.

The genus struthio contains four species, all of them possessing great bulk and power, and entitled to a distinct notice. They are as follows:

1. *Ostrich.*

Struthio-camelus---LINN.

This species is characterised by having only two toes to the foot. Though the power of flying may be considered as the distinguished attribute of the feathered tribes in general, yet there are some particular families to which nature has denied that endowment; while she has granted it to a few of the quadrupeds, and even of fishes. It is thus that she displays the extent of her power, by the variety of her productions, and disdains to be confined within the narrow limits prescribed to her by the systems of philosophers. As we descend from the class of quadrupeds to contemplate that of birds, we find the connecting links, which unite these two orders into one great chain, very short, and almost imperceptible; for, while the flying-squirrel, the bat, and some of the inferior quadrupeds, are invested with the power of flight, and with other properties of birds, the ostrich, dodo, and cassowary, are, by their enormous size, confined to the ground, and indicate, by their habits, a near affinity to the four-footed animals. Thus, as we descend from those swift and slender birds, which are destined to move in the higher regions of the air, we find them growing, by gradual and

almost imperceptible degrees, heavier and less agile; till, at length, being wholly destitute of the qualities necessary for flight, they are incapable of rising from the surface of the earth.

The ostrich is the largest of all birds, and, from this prerogative in a great measure, is incapable of flight, the great prerogative of the order. Its weight is about fourscore pounds; its height, from the top of the head to the ground, is from seven to nine feet; length, from the beak to the tip of the tail, is about the same. When walking, it seems as tall as a man on horseback. The plumage of the ostrich, however, as well as its weight, is an insuperable bar against its ever rising into the air. The vanes of the wing feathers are separate and detached, like hairs, and incapable of making any impression on the atmosphere. Those of the tail, and, indeed, of the whole body, are of the same structure. They are all as soft as down, and utterly unfit, not only for flying, but for defending the body of the animal from external injury. The feathers of other birds have their webs broader on the one side than on the other; but those of the ostrich have the shaft exactly in the middle. The head, upper part of the neck, sides and thighs, are covered, instead of with feathers, with a clear and white kind of hair, which, on the head, somewhat resembles the bristles of a hog. The thighs of this bird, in which its strength seems chiefly to reside, are large and muscular; and its hard and scaly legs, which are supported by two thick toes, have a striking similarity to those of a goat. These toes are of unequal size; the inner, which is both longer and thicker, being seven inches in length, including the claw. The other, which is without a claw, is only four inches. It is the only bird that possesses eyelids, and these are fringed.

The internal structure of the ostrich exhibits still more decisive proofs of its affinity to the race of quadrupeds, and of its deviation from that of birds. The heart and lungs are separated by a midriffe, as in quadrupeds; while the sexual organs bear an equal resemblance and analogy; as do also the kidneys, which differ from those of other birds, in not being divided into two lobes. It has two stomachs, the one larger, resembling the crop of other birds; and the other smaller, and constructed like the stomach in the human species. The first is furnished with a large number of muscular fibres, and seems to act by trituration; while the second, which acts by means of a gastric liquor, is, on opening the bird, constantly found filled with a variety of different substances, vege-

tables, grain, flesh, and even with stones, glass or iron. It lays from forty to fifty eggs, as large as the head of a child.

Though the ostrich be a bird known from the earliest ages, it is probable that we are unacquainted with many interesting particulars relating to its history. The authors of the sacred volume have many comparisons drawn from its manners; and, as an article of food, we know it was forbidden to the Jews. Aristotle also mentions this bird, as no less remarkable for its size than fecundity. In those parched deserts of Africa, however, where it resides, and where it runs with such precipitation on the approach of any invader, it can seldom become an object of close examination, particularly to men of such curiosity as might induce them to describe its manners. The race of these birds, though ancient, still remains pure, and almost solitary. Like the elephant among quadrupeds, the ostrich constitutes a genus offering few or no varieties, and perfectly distinguished by characters equally striking and permanent.

The ostrich is peculiar to Africa, to the neighbouring islands, and to those parts of Asia that lie in the vicinity of the African continent. The native country of the rhinoceros and the elephant, of the latter of which the ostrich is the representative among birds, is also the birth-place of this singular creature. It is seldom found beyond the distance of thirty-five degrees from the line, on either side; and, as it is incapable of flight, it must, like the quadrupeds of these latitudes, have always been confined to the ancient continent. It prefers, for its residence, those mountains, and parched deserts, that are never refreshed by rain; a circumstance which tends to corroborate the report of the Arabs, that these birds never drink. Vast flocks of them are seen in these barren and solitary regions. At a distance they appear like an army of cavalry, and often alarm the caravans that are travelling through them.

The spoils of the ostrich are too valuable a prize to the huntsmen, to admit of his remaining undisturbed, even in those wild retreats. Among some nations, their eggs, their blood, their fat, and their flesh, have been eagerly sought, as articles of food. Whole nations have obtained the appellation of Struthophagi, from their partiality for this food; and even the luxurious Romans themselves, as we learn from Apicius, considered the flesh of the ostrich as a delicacy. The emperor Heliogabalus, so justly famed for his extravagance and tasteless profusion, caused, on one day, the brains of six hundred of them to be served up at one meal. At the present

day, the inhabitants of Numidia are said to tame them, in order to live upon their flesh, and sell their feathers. Their eggs are about thirty times heavier than those of our common hens, and furnish a plentiful repast for eighteen men. Buffon, however, thinks those writers guilty of exaggeration who have stated their weight at fifteen pounds.

The beauty of the plumage of the ostrich, particularly of the long feathers that compose his wings and tail, is the chief reason why man has been so active in pursuing him into deserts, at so much expence and labour. The Arabs, who make a trade of killing these birds, formerly converted their skins into a kind of cuirass and buckler. The ancients used their plumes as ornaments for their helmets. The ladies in the east make them still an ornament in their dress; and not long since, the fine gentlemen of our own country made use of them in decorating their hats. In Turkey, the janissary, who has signalized himself by some military achievement, is allowed to assume them as a decoration to his turban; and the sultan, in the seraglio, when meditating conquests, and feats of a gentle nature, puts them on, as the most irresistible ornament of his person.

The spoils of the ostrich being thus a valuable article of commerce, the hunting of that bird is one of the most serious employments of the Arabs, who train the fleetest horses for the purpose. Although the ostrich be far swifter than the best courser, yet, by hunters on horseback, he is commonly taken; and, of all the varieties of the chace, this is perhaps the most laborious. The Arab, when mounted, still keeps the ostrich in view, without pushing him so close as to make him escape to the distant mountains; but, at the same time, so as to prevent him from taking any food. This is the more easily done, as the foolish bird takes his course in a waving and circuitous direction, which is greatly shortened by the hunters, who come up behind, and, relieving each other by turns, thus keep him still running. After two or three days of fatigue and famine, he becomes so exhausted, that the hunters fall upon him, and, in a few moments dispatch him, by striking him on the head with cudgels, that his blood may not tarnish the lustre of his white feathers. It is said, that when he finds all possibility of escape cut off, the ostrich hides his head, in the vain expectation that the whole of his body will then be concealed from his pursuers. There are still other methods

of hunting the ostrich, as with dogs and nets; but that practised by the Struthophagi appears most ingenious. They covered themselves with ostrich skins; and, passing their arms through the necks of them, counterfeited all the motions of these birds. When admitted into their society, they readily surprised them.

The ostriches, though inhabitants of the desert, and possessed of prodigious strength, are, especially if taken when young, neither so fierce nor so difficult to tame as might be expected. The inhabitants of Dara and Libya are said to render them almost domestic, like herds of cattle, with scarcely any other means than constantly accustoming them to the sight of man; to receive from him their food; and to be treated with gentleness.

Besides the use of their feathers, ostriches, in their domestic state, are said to be mounted and rode upon in the same manner as horses. Firmius, an Egyptian prince of the third century, used them for that purpose; and, in after times, Moore assures us, that, at Ivar, in Africa, he saw a man travelling upon an ostrich. Adanson asserts, that, at the factory of Podore, he had himself two ostriches, that, although young, run faster than a race-horse, with two negroes on their backs. But, although these birds may be so tamed, that, like cattle, they will suffer themselves to be driven in flocks to and from their stalls, and even to be mounted like horses; yet there is reason to apprehend, from their invincible stupidity, they can never be taught to obey the hand of the rider, to comprehend the meaning of his commands, or to submit to his will. For it appears, by Adanson's narrative, that the ostriches at Podore, though they did not run to a great distance, scampered several times around the village, and that they could only be stopped by barricading the passage. From this intractable disposition, there is reason to apprehend, that man will never be able to avail himself of the strength and swiftness of the ostrich, as he has availed himself of those qualities in the horse.

The voracity of this bird far exceeds that of any animal whatever, for it will devour, and that with equal greediness, every thing that it meets with; stones, wood, brass, iron, or leather, as readily as it will grain and fruit, which, in its native wilds, are probably its principal food. Those dissected by Warren and Ramby, had their stomachs so crammed with these hetereogeneous substances, that they were astonished that these animals were able to digest such a mass. The fact is, notwithstanding the marvellous accounts of this

bird's digestive powers, that iron, and other hard substances, pass through it without undergoing a greater change by the action of its stomach, than they are known from experience to undergo in passing through the stomach and intestines of the common hen or turkey. Whether by trituration, or by the gastric juice, it is not, perhaps, yet fully ascertained; but it is a well established fact, that all metals lose somewhat of their weight when exposed to the action of the stomach of birds.

The cause of the insatiable voracity of the ostrich is the largeness of its stomachs, and the necessity it is under of filling them; its swallowing indiscriminately whatever comes in its way, arises from its want of taste and smell. The tongue and mouth are covered with a soft cartilaginous substance, which renders them insensible to the particles of any body that is applied to them. So obtuse and dull is its sense of smell, that this bird will devour what is perfectly poisonous. Vallisnieri saw one that had died from having swallowed a large quantity of quick lime.

This bird is highly salacious, but observes a strict connubial fidelity to his female; a circumstance which is contrary to the usage of most of the heavy birds. The season at which ostriches lay, varies with the temperature of the climate. Those on the north side of the line begin about the first of July; while such as inhabit the south of Africa defer it to the latter end of December. Climate and situation have also a great influence on their manner of incubation. In the torrid zone the ostrich is contented with depositing her eggs in a mass of sand, carelessly scraped together with her feet. There they are sufficiently heated by the warmth of the sun, and need the incubation of the female only for a little during the night. But although the ostrich be but little engaged in hatching her eggs, she displays, by continual watching for the preservation of her nascent progeny, all the solicitude of a tender mother: and there is a cruel method of catching them, founded upon this parental affection, which consists in planting around the nest a number of sharp pales, upon which the female stabs herself in her haste to return to her eggs. In proportion to the coldness of the climate, the ostrich hatches with more assiduity; and it is only in the warm regions, where there is no danger of her eggs being chilled, that she leaves them by day; a circumstance from which she very early incurred the reproach of being destitute of affection. So far, however, is this from being true, that she con-

tinually watches for their preservation, so long as they remain in a helpless state, which is longer or shorter according to the climate. Neither the size of the eggs of these birds, nor the time necessary for hatching them, nor the number of their young, are exactly ascertained. Some accounts say, that they produce twice or thrice in the year, each brood containing ten or twelve young. Willoughby assigns them no less than fifty eggs in a year; a number, which, at the weight of fifteen pounds each, would make the bird produce seven hundred and fifty pounds weight of eggs; too much, surely, for an animal weighing only eighty pounds.

2. *Rhea, or American Ostrich.*

Struthio-rhea.---LINN

Feet three-toed, and a round callus behind. This bird is so nearly allied to the ostrich, that it may be considered as his representative in the New Continent, to which it peculiarly belongs. It inhabits Guiana, Brazil, Chili, and those immense forests that extend northward from the mouth of the river Plata; and is found as far south as the Megallanic Straits. Formerly these birds were more widely spread over South America; but, in proportion as population increased, these timid animals fled from their habitations, or became victims to superior power.

The rhea, being next in size to the black ostrich, is by far the largest bird in the New World. The adults are six feet high; and Wafer, who measured the thigh of one of the tallest, found it equal to that of a man; while the leg was three feet long. It has the long neck, small head, and flat beak, that distinguish the black ostrich; but, in other respects, it has a great resemblance to the cassowary. The shape of the body is oval; and, when covered fully with feathers, approaches to rotundity. Its wings are so short as to be useless for flight, but like those of the ostrich, may probably give some assistance in running. The back and rump are covered with long feathers, which hang down over the anus, and form what, in this animal, is the tail. The whole upper part of the body is covered with grey plumage, and the under with white. The toes are three, all before: behind there is a callous kind of heel, which supports the bird, and is supposed to assist it in running. It possesses the same remarkable velocity which characterizes the ostrich; and its running is attended with a singular motion of its wings. It raises one for some time above the body,

and then drops it to erect the other, and holds it, for a while, in the same strange position. Such is their velocity, that the savages are obliged to lay snares in order to catch them; for they are in vain chaced by the swiftest dogs.

The rhea shews the same indiscriminate voracity as the ostrich. Like it, it devours stones, iron, and hard substances; and, as this is a quality peculiar to all the granivorous tribes, it is probable that fruit, grain, and vegetable substances are the natural food of this bird. The fable told of the male compelling a number of females to lay in the same nest, and then charging himself with the task of incubation, deserves no credit; nor is the circumstance less romantic of his separating from the nest two eggs, upon which he does not sit, but allows to addle, that, by breaking them in that state, he may collect insects to feed the young. It is probable that the eggs of the rhea, like those of the ostrich, are hatched partly by the heat of the sun, and partly by incubation. The young, says Wafer, when first excluded from the shell, are so familiar, that they follow the first person they meet; but, on growing older, they acquire experience, and become more shy and suspicious. The flesh of the young rhea is reckoned good eating; and it might, perhaps, be improved, and rendered more abundant by domestication, as has been that of the turkey or common hen, which, like the rhea, are indigenous to the burning regions of the torrid zone. The former, in particular, originally inhabited the same tracts of the American continent. The bird defends itself with its feet, and calls its young by a kind of hiss.

3. *Emen or Cassowary.*

Struthio-casuarius.—Linn.

Feet three-toed; helmets and dew-laps naked. This bird inhabits the torrid zone, and especially the island of Java, whence it was first brought into Europe in 1597. Its habitation begins in those temperate climes, which are contiguous to the precincts of the ostrich; and, as it occupies a region more favourable to the multiplication of the human race, its members are continually decreasing in proportion to the increase of the number of its destroyers.

Next to the ostrich and rhea, the cassowaries are the largest birds of the feathered race. They are of various sizes. The one described by the Academy of Sciences in Paris was five feet and a

half from the bill to the claw. The Dutch compare the bulk of these birds to that of a sheep. From the shortness of the legs and neck, they are not so tall as the ostrich; but the body has a more heavy and clumsy appearance to the eye. The most remarkable trait in the appearance of these birds, is a sort of helmet upon the head, which reaches from the base of the bill to the crown: it is nearly three inches in height, and, at the root, is three in thickness. The middle of the upper eyelid is furnished with a row of black hairs, which gives the animal a kind of wild aspect, that the large aperture of the beak renders still more fierce and menacing. The head and upper part of the neck are almost naked, being only here and there interspersed with blackish hairs, that partially cover a blue wrinkled skin. The feathers that cover the body of the cassowary, as well as those for flight, are all of one kind, and of the same blackish colour. They are generally double, having two shafts that grow from one short trunk, which is fixed in the skin. The small fibres of which the vanes are composed have so little adhesion to each other, that the bird, when viewed at a distance, seems clothed with hair rather than with feathers. The wings of the cassowary are still shorter than those of the ostrich, and, by consequence, still more unfit for flying. They are furnished each with four hard-pointed feathers, resembling darts, of which the longest, which is eleven inches, is a quarter of an inch thick in the root. Its feet are also armed with large black claws, which give the animal an appearance of being formed for hostility. But, though supplied with weapons that might render it very formidable to the rest of the animal world, the cassowary leads a peaceable and inoffensive life. It never attacks others; and nothing short of necessity will make it even defend itself. When it does defend itself, it kicks like a horse, and pushes down its assailant by running against him, and grunting like a swine.

The movements of the cassowary, when travelling, are awkward, and apparently heavy. It seems to give a kind of kick backward for every hop it makes forward; but, so much is swiftness the prerogative of birds, that the cassowary, which is among the dullest of the tribe, will outrun the fleetest steed. It is distinguished by the same voracity which characterises the rhea and ostrich. It swallows every substance that is offered to it, that is not too large for the circumference of its throat; and possesses the

faculty of rejecting its food, when disagreeable, with the same dispatch with which it swallowed it.

The female lays a number of ash-coloured spotted eggs, about thirteen inches in circumference one way, and six the other, of a greenish colour, with still deeper green spots.

4. *New Holland Cassowary.*

Struthio Novæ Hollandiæ.

FEET three-toed; crown flat; shanks serrate behind. This species inhabits New Holland, and is nearly as tall as the black ostrich, being not less than seven feet two inches in height. Like the rest of the genus, it runs with prodigious speed, and escapes the pursuit of the greyhound. Bill black; head, neck, and body covered with bristly feathers, varied with brown and grey; throat nakedish, blueish; feathers of the body a little incurved at the tip; wings hardly visible; legs brown.

[*Pantologia.*

SECTION VII.

Thrush kind.

Turdus.—LINN.

THE genus turdus is one of the most voluminous in ornithology, including not fewer than one hundred and and thirty-six species scattered over the globe; of which some are inhabitants of our country.

To this numerous division belong more especially the missel, common thrush, field-fare, black-bird, and mocking-bird; each of which we shall proceed to describe.

The French term the birds of this genus, that have speckled and variegated plumage, grives; and those of a more uniform hue, merles. In the thrush tribes, the male and female are pretty nearly of the same size: they are generally subject to a variation of colour, in different seasons of the year. The outer toe is connected with the middle by a membrane, as far as the first joint: their bill is denticulated towards the point, and none of them feed upon grain, which is probably too hard for their stomachs to digest. They are properly baccivorous; but to this food they add insects and worms; hence they are frequently seen scratching the ground, especially after rain, when these animals come to the surface.

Among the Romans some species of the thrush were deemed exquisite food; whence Martial:

"Inter aves turdus, inter quadrupes, gloria prima, lepus;"

and, to procure a supply of it, no labour or expence was spared by that sensual and luxurious people. They constructed large aviaries, fit for the reception of many thousands of these devoted creatures, along with equal numbers of quails, ortalans, and other birds reckoned delicate eating. Such vast numbers of these aviaries were erected in the vicinity of Rome, that their dung was employed as a manure for the fields, like that of the dove-houses with us.

In these aviaries, however, the Roman birds enjoyed not the same liberty with our dove-house pigeons; for they were never allowed to escape, and, by consequence, they seldom laid, or produced young. As, however, they were provided with abundance of well-chosen food, they readily fattened, to the great profit of the proprietor. Their ordinary price was about two shillings a-piece; but, about the time of a public triumph, or any grand festival, they far exceeded that sum. These aviaries were large vaulted buildings, supplied with a number of joists, upon which the birds might perch. They were but obscurely lighted, so that the prisoners might never see the fields, the woods, or the wild birds fluttering at their liberty; images which could not fail to excite a regret for their lost freedom, and to prevent them from fattening. Slaves, says Buffon, should never see too clearly; and they took care that these should only be able to distinguish the different objects that were to supply their wants. They were fed with millet, and a sort of paste made up of bruised figs and meal; to these were added ivy and myrtle berries, and every thing that could give a relish and succulency to their flesh. They got water from a small stream that ran across the aviary. For about twenty days before they were killed for eating, their quantity of food was increased, and care taken that it should be of a more nutritive quality. So far was the attention to this business carried, that the owners made those that were fat, and ready for being taken, pass gently into a small chamber adjoining the aviary, where they cut off all communication between them and those that were left, that the latter might not be disturbed by catching the former. With the latter they tried every method to keep up the illusion of

liberty. From time to time they lined the walls of the aviary with green branches and leaves, that the birds might still fancy themselves in the midst of the grove. Thus they were accustomed, by degrees, to captivity; they were slaves kindly treated by their master, because he understood his own interest. This account of Roman epicurism is attested both by Columella and Varro; and, from their relations, Buffon has compiled a very curious history of the ancient aviaries of the Romans.

An improvement upon this practice of the Romans is said to be invented in modern times, and applied to practice in some provinces of France, where the inhabitants fasten earthen pots among the branches of trees, which the thrushes frequent. In these the birds find a convenient shelter from the weather without losing their liberty; and hence they seldom fail to prefer them to nests of their own construction. Partly from the security afforded to the young in these pots, and partly from the great saving of labour to the parent birds, who are thus enabled to bring up two families every year, thrushes have been found to multiply greatly under this mode of treatment. When the birds are not thus aided by the art of man, their nests are finished with great difficulty and labour. Outwardly they are constructed of moss, straw, and dried leaves; and in the inside they are overlaid with a thick plaister of baked clay and hair. Some kinds are not even satisfied with this, but garnish the inside still farther with feathers of various kinds.

Thrushes are in general grave and melancholy. Their innate love of liberty is not easily overcome by domestication. Seldom are they seen to fight, sport, or play with each other, in their natural state, and far less in a state of captivity, which they never relish. Some of these birds, however, become excellent songsters by education; and the throstle has, in several instances, added to the talent of music that of speech. Such, at least, is the account given by Pliny of a thrush tamed by the empress Agrippina.

1. *Missel, or Missel-bird.*

Turdus viscivorus.—Linn.

Back brown; neck spotted with white; bill yellowish. Eleven inches long; builds in bushes or on the side of some trees; and lays four or five eggs. Sings finely in the spring, sitting on the

summit of a tree. The missel is peculiarly distinguished, being the largest British bird that has any harmony in its voice. All that are of superior size having a screaming or croaking note; whence they are properly introduced by Thomson into the concert of the grove, as if to supply a kind of bass or chorus to the smaller warblers. Even the missel discovers its affinity to the superior tribes, by the harsh screaming sound it utters, when moved by anger or fear. It feeds upon holly and missletoe-berries, and insects, and may be regarded as sovereign of the grove; for it drives away from the coppice all the inferior species of the thrush kind.

2. *Song Thrush, or Throstle.*

Turdus musicus.—Linn.

Quill-feathers ferruginous at the inner base. Inhabits the woods of Europe; nine inches long; builds in a low bush a nest of earth, moss, and straw, plaistered with clay within; lays five or six pale blueish eggs with dusky spots. In France this bird is migratory; but remains in England during the whole year. It arrives in France about the time of the vintage, when it frequently feeds to excess on the juice of the ripe grape; a circumstance from which it has, in France, obtained also the name of the vine-thrush. This bird is remarkably prolific, producing, in some countries, no less than three different families in one season. Of all the thrush kind it is the most accomplished singer; and feeling frequent returns of the amorous passion, which is the source of all the harmony of the grove, it is said to sing during three quarters of the year. When it begins to warble, it perches upon a high branch of one of the tallest trees, from which it pours forth its melody for hours together. Its song is composed of several notes, which it has skill artfully to combine. From this superior compass and modulation of voice, it has, in many countries, as well as in our own, obtained a name indicative of its musical powers.

This species of thrush is widely diffused over Europe. It is frequent in Scotland, England, France, Germany, and Sweden. Although timid, and apparently possessed of cunning, yet it does not avoid the snares that are laid for it. There are some districts in Poland where such numbers are caught that they are exported toother countries. The quality of the flesh of this, as of all kinds of birds, depends greatly on the food upon which it subsists. At

one season, therefore, it may be palatable, and intolerable at another. It seems to be no where in such request at present, as it was among the ancient Romans. There are several varieties of the song thrush in Europe, and three or four in America.

3. *Fieldfare.*

Turdus pilaris.—Linn.

Tail-feathers black, the outermost at the inner edge tipped with white; head and rump hoary. There are three or four other varieties; as spotted with black; the head, neck, and body beneath, white; head and neck white, body as in the first, or white with large blackish spots. The bill is yellow; and the legs of a deep brown. This species forms a part of that unfortunate race of warblers which are the annual victims of the bird-catching art. They visit this country about Michaelmas, and leave it about March; and the bird-catchers attempt to take them during their passage. They live upon the fruit of the hawthorn, and almost every species of berry, during the winter, when they are seen in flocks, sometimes of a thousand, on the same field.

They are more easily tamed than the other thrushes, but reward not, with their song, the labour bestowed on their education. Linnæus mentions an instance of one that was tamed in the house of a wine-merchant, that became so familiar as to drink wine out of the glasses upon the table. The effects of this liquor made it throw its feathers, which were renewed, after it had been confined for a while in the cage, and had been obliged to lead a more temperate life.

The numbers, as well as the appearance, of these birds in this country, seem to be determined by the rigour of the season; and they are said to have a presentiment of its cessation; whence, as long as they are in the field, the inhabitants of the country conclude that the severity of the winter is not past. Their summer residence is Syria, Southern Siberia, or the neighbouring districts, where they feed upon juniper-berries; whence their flesh contracts a bitterness, which some have thought agreeable. The young of the missel, when put into the nest of the fieldfare, are adopted by the female, and reared with the same care as her own; from which it has been rashly concluded that a mixed race might be procured by the union of these two species. No such breed, however, has ever been obtained, though many families of the former have been reared by the maternal care of the latter.

4. *Blackbird, or Black-ouzel.*

Turdus merula.—Linn.

Black; bill and eye-lids yellow. Three other varieties; one, the head white; another, body white; a third, variegated black and white. Inhabits Europe and Asia; frequents hedges and thickets, and lays four or five blueish-green spotted eggs. The blackbird has often been tamed, on account of its song. Its voice, however, is too loud and harsh for any place but the woods. It is said, indeed, to be capable of great improvement, from a faculty which it possesses of imitating the sounds of any musical instrument. Some, that have been well educated, sing part of an air very justly. We have not, however, witnessed any instance of their being able to retain a tune of any length or variety of notes.

In their manners these birds differ considerably from the song-thrush: they neither travel, nor associate together in flocks; but, though more shy towards each other, they are less so with regard to man. They are easily tamed by him, and reside, from choice, near his habitation. Endowed with a piercing eye, and accustomed to be always on the watch against an enemy so near, they have acquired great credit for their cunning. On experience, however, they have been found to be more restless than artful, rather timid than distrustful; for there is hardly any kind of snare in which they may not be taken, provided the hand that lays it can render itself invisible.

When the blackbird is enclosed in the same cage with other songsters of inferior size, his restless habits are changed into an overbearing petulance: he incessantly pursues and torments his fellow-prisoners. He should never, therefore, be placed in the same apartment with smaller birds, nor allowed to enter a company to which his behaviour is so rude.

It has been asserted by the ancient naturalists, that the blackbird never moults, because he is heard to sing during winter, a period when the other birds are silent. Nature, however, seldom acknowledges any race of privileged beings which she exempts from her general laws. The more accurate observation of the moderns has discovered the moulting season of this bird, which is at the end of summer. Then they are seen, along with their young, sometimes almost half naked.

In spring they procreate very early. The nest is made of moss, grass, &c. lined with clay, and covered over afterwards with hay. They feed upon fruit and insects of every kind.

5. *Ring-ouzel.*

Turdus torquatus.—LINN.

BLACKISH; bill yellowish; collar white. There are one or two other varieties from diversity of colour, which are called water-ouzel and rock-ouzel. The French name merle is applied to all three. The middle of the breast of the ring-ouzel is beautifully ornamented with its crescent of pure white; the horns pointing to the hind part of the neck. The water-ouzel is the most retired of this solitary tribe: it is commonly seen single, hopping by small brooks, or steep banks. It lives upon insects and small fishes; and, though unprovided with webbed feet, will dive in pursuit of them. But the most beautiful of this tribe is the carnation or rose-coloured ouzel, which, Linnæus informs us, is an inhabitant of Lapland and Switzerland. One or two of these birds have been seen in Britain, where they were supposed to have strayed in their migrations from Lapland to the south of Europe. The breast, belly, back, and coverts of the wings, of this beautiful species, are of the colour of a rose of two tints, of which the one is pale and the other deeper. The head, neck, wings, and tail, shine with different reflections of purple and green. The ouzel inhabits Europe, Asia, and Africa; is eleven inches long, migrates in flocks, and feeds on insects and berries.

6. *Mocking-bird, or Mimic Thrush.*

Turdus polyglottus.—LINN.

DUSKY ash, beneath pale ash; primary quill feathers white on the outer half. Nine inches and a half long; feeds on berries, fruits, and insects. This bird forms a striking exception to the general character which naturalists have given of the birds of the new world. It is allowed by all travellers that the rich, lively, and brilliant hues of the feathered race, in that continent, are strongly counter-balanced by their harsh, monstrous, and disagreeable tones. The mocking-bird, however, is represented as the most melodious of all birds, the nightingale itself not excepted. To the charms of its natural song it adds the wonderful faculty of

counterfeiting the notes of every bird in the woods. Far from ridiculing the songs which he repeats, he seems only to imitate in order to improve them, and to perfect and increase his own powers by exercising them in every possible manner. The mocking-bird not only sings with taste, but with action and vivacity: he accompanies every note, whether natural or acquired, with corresponding gestures of the body. If the air he warbles be brisk and lively, he beats time by the rapid and fluttering motions of his wings. If his voice, from a loud and full tone, die away by gentle cadences, into a perfect silence, more charming than melody itself, he is skimming, at the same time, above his tree, gradually lessening the undulations of his wings, till at last he seems to rest suspended and motionless on the bosom of the air.

With all these qualifications that endear him to man, the mocking bird is of a very ordinary appearance, compared with the other tenants of the American woods. The upper parts of the body are of a brownish-grey; and the breast and belly white. Under this plain appearance, which has neither lustre nor variety of colours, he amuses or deceives every animal in the forest.

He seems to sport with the hopes and fears of the small birds; at one time alluring them by the call of their mates, and then terrifying them, after their approach, with the screams of the eagle, or other birds of prey. As there is no bird which it cannot imitate, so there is none that it has not at times deceived by its call. It is found in Carolina, Jamaica, New Spain, and, in general, inhabits most of the warm or temperate climates of America. It is fond of the vicinity of man, and is easily domesticated. It perches on the trees around the planter's houses, and sometimes upon the chimney tops, where it remains all night, pouring forth the sweetest and most various notes of any of the feathered tribes.

[*Pantologia.*

SECTION IX.

Pigeon.

Columba.—Linn.

The tame pigeon, and all its beautiful varieties, derive their origin from one species, the stock dove; the English name implying its being the *stock* or *stem* from whence the other domestic kinds sprung. These birds, as Varro observes, take their (Latin)

name, *Columba*, from their voice or cooing: and had he known it, he might have added the British, &c. for *K'lommen*, *Kyloh-man*, *Kulm* and *Kolm*, signify the same property and same bird. They were, and still are, in most parts of our island, in a state of nature; but probably the Romans taught us the method of making them domestic, and constructing pigeon-houses. Its character, in the state nearest that of its origin, is a deep bluish ash-colour; the breast dashed with a fine changeable green and purple; the sides of the neck with shining copper colour; its wings marked with two black bars, one on the coverts of the wings, the other on the quill-feathers. The back white, and the tail barred near the end with black. The weight fourteen ounces.

In the wild state it breeds in holes of rocks, and hollows of trees, for which reason some writers stile it *columba cavernalis*, in opposition to the ring dove, which makes its nests on the boughs of trees. Nature ever preserves some agreement in the manners, characters, and colours of birds, reclaimed from their wild state. This species of pigeon soon takes to build in artificial cavities, and from the temptations of a ready provision becomes easily domesticated. The drakes of the tame duck, however they may vary in colour, ever retain the mark of their origin from our English mallard, by the curled feathers of the tail; and the tame goose betrays its descent from the wild kind, by the invariable whiteness of its rump, which they always retain in both states.

Multitudes of these birds are observed to migrate into the south of England; and while the beech woods were suffered to cover large tracts of ground, they used to haunt them in myriads, reaching in strings of a mile in length, as they went out in the morning to feed. They visit us the latest of any bird of passage, not appearing till November, and retire in the spring. I imagine that the summer haunts of these are in Sweden, for Mr. Eckmark makes their retreat thence coincide with their arrival here. But many breed here, as I have observed, on the cliffs of the coast of Wales, and of the Hebrides.

The varieties produced from the domestic pigeon are very numerous, and extremely elegant; these are distinguished by names expressive of their several properties, such as tumblers, carriers, jacobins, croppers, pouters, runts, turbits, owls, nuns, &c. The most celebrated of these is the carrier; which, from the superior attachment that pigeon shews to its native place, is employed in

many countries as the most expeditious courier; the letters are tied under its wing, it is let loose, and in a very short space returns to the home it was brought from, with its advices. This practice was much in vogue in the East; and at Scanderoon, till late years, used on the arrival of a ship, to give the merchants at Aleppo a more expeditious notiçe than could be done by any other means. In our own country, these aërial messengers have been employed for a very singular purpose, being let loose at Tyburn at the moment the fatal cart is drawn away, to notify to distant friends the departure of the unhappy criminal.

In the East, the use of these birds seems to have been improved greatly, by having, if we may use the expression, relays of them ready to spread intelligence to all parts of the country. Thus the governor of Damiata circulated the news of the death of Orrilo:

> Tosto che'l Castellan di Damiata
> Certificossi, ch'era morto Orrilo,
> La Colomba lasciò, ch'avea legata
> Sotto l'ala ál lattera col fila.
> Quelle andò al Cairo, ed indi fu lasciata
> Un'altra altrove, come quivi e stilo:
> Sil, che in pochissime ore andò l'avviso
> Per tutto Egitto, ch'era Orrilo ucciso *.

But the simple use of them was known in very early times: Anacreon tells us, he conveyed his billet-doux to his beautiful Bathyllus by a dove.

> Εγω δ' 'Ανακρεοντι
> Διάκοιω το ταυτα·
> Και νυν οιας ἐκεινȣ
> 'Επιστολας κομιζω †.

> I am now Anacreon's slave,
> And to me entrusted have

* "As soon as the commandant of Damiata heard that Orrilo was dead, he let loose a pigeon, under whose wing he had tied a letter: this fled to Cairo, from whence a second was dispatched to another place, as is usual: so that in a very few hours all Egypt was acquainted with the death of Orrilo."—ARIOSTO, canto 15.

† Anacreon, ode 9, εἰς περιςεραν

All the overflowings of his heart
To Bathyllus to impart;
Each soft line, with nimble wing,
To the lovely boy I bring.

Taurosthenes also, by means of a pigeon he had decked with purple, sent advice to his father, who lived in the isle of Ægina, of his victory in the Olympic games, on the very day he had obtained it. And, at the siege of Modena, Hirtius without, and Brutus within the walls, kept, by the help of pigeons, a constant correspondence; baffling every stratagem of the besieger Antony, to intercept their couriers. In the times of the crusade, there were many more instances of these birds of peace being employed in the service of war; Joinville relates one during the crusade of Saint Louis; and Tasso another, during the siege of Jerusalem.

The nature of pigeons is to be gregarious; to lay only two eggs; to breed many times in the year; to bill in their courtship; for the male and female to sit by turns, and also to feed their young; to cast their provision out of their craw into the young one's mouths; to drink, not like other birds by sipping, but by continual draughts, like quadrupeds; and to have notes mournful or plaintive. [*Pennant.*

SECTION X.

Bullfinch.

Lexia pyrrhula.—Linn.

The wild note of this bird is not in the least musical; but when tamed it becomes remarkably docile, and may be taught any tune after a pipe, or to whistle any notes in the justest manner; it seldom forgets what it has learned; and will become so tame as to come at call, perch on its master's shoulders, and (at command) go through a difficult musical lesson. They may be taught to speak; and some thus instructed are annually brought to London from Germany.

The male is distinguished from the female by the superior blackness of its crown, and by the rich crimson that adorns the cheeks, breast, belly, and throat, of the male: those of the female being of a dirty colour: the bill is black, short, and very thick; the head large; the hind part of the neck and the back are grey; the

coverts of the wings are black; the lower crossed with a white line: the quill-feathers dusky, but part of their inner webs white; the coverts of the tail and vent-feathers white; the tail black.

In the spring these birds frequent our gardens, and are very destructive to our fruit-trees, by eating the tender buds. They breed about the latter end of May, or beginning of June, and are seldom seen at that time nean houses, as they chuse some very retired place to breed in. These birds are sometimes wholly black. I have heard of a male bullfinch which had changed its colours, after it had been taken in full feather, and with all its fine teints. The first year it began to assume a dull hue, blackening every year, till in the fourth it attained the deepest degree of that colour. This was communicated to be by the Rev. Mr. White, of Selborne. Mr. Morton, in his *History of Northamptonshire*, gives another instance of such a change; with this addition, that the year following, after moulting, the bird recovered its native colours. Bullfinches fed entirely on hemp-seed, are aptest to undergo this change. [*Pennant*.

SECTION XI.

Goldfinch.

Fringilla carduelis.—LINN.

THIS is the most beautiful of our hard-billed small birds; whether we consider its colours, the elegance of its form, or the music of its note. The bill is white, tipt with black; the base is surrounded with a ring of rich scarlet feathers; from the corners of the mouth to the eyes is a black line; the cheeks are white; the top of the head is black; and the white on the cheeks is bounded almost to the fore part of the neck with black; the hind part of the head is white; the back, rump, and breast, are of a fine pale tawny brown, lightest on the two last; the belly is white; the covert feathers of the wings, in the male, are black; the quill-feathers black, marked in their middle with a beautiful yellow; the tips white; the tail is black, but most of the feathers marked near their ends with a white spot: the legs are white.

The female is distinguished from the male by these notes; the feathers at the end of the bill, in the former, are brown; in the male black; the lesser coverts of the wings are brown; and the black and yellow in the wings of the female are less brilliant. The

young bird, before it moults, is grey on the head; and hence it is termed by the bird catchers a *grey pate.*

There is another variety of goldfinch, which is, perhaps, not taken above once in two or three years, which is called, by the London bird-catchers, a *cheverel*, from the manner in which it concludes its jerk: when this sort is taken, it sells at a very high price; it is distinguished from the common sort by a white streak, or by two, and sometimes three white spots, under the throat.

The note is very sweet, and they are much esteemed on that account, as well as for their great docility. Toward winter they assemble in flocks, and feed on seeds of different kinds, particularly those of the thistle. It is fond of orchards, and frequently builds in an apple or pear tree: its nest is very elegantly formed of fine moss, liver-worts, and bents on the outside; lined first with wool and hair, and then with the goslin, or cotton of the sallow. It lays five white eggs, marked with deep purple spots on the upper end.

This bird seems to have been the *χρυσομιτρις** of Aristotle: being the only one, that we know of, that could be distinguished by a golden fillet round its head, feeding on the seeds of prickly plants. The very ingenious translator (Dr. Martyn) of Virgil's Eclogues and Georgics, gives the name of this bird to the *acalanthis* or *acanthis*,

> Littoraque *alcyonen* resonant, *acanthida* dumi.

In our account of the *Halcyon* of the ancients, we followed his opinion; but having since met with a passage in Aristotle, that clearly proves that *acanthis* could not be used in that sense, we beg, that, till we can discover what it really is, the word may be rendered *linnet;* since it is impossible the philosopher could distinguish a bird of such striking and brilliant colours as the *goldfinch*, by the epithet *κακοχροος*, or bad coloured; and as he celebrates his *acanthis* for a fine note, *φωνην μὲν τοι λιγυραν εχουσι*, both characters will suit the linnet, being a bird as remarkable for the sweetness of its note, as for the plainness of its plumage.

[*Pennant.*

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* Which he places among the *ακανθοφαγα*. Scaliger reads the word *ρυσομιτρις*, which has no meaning; neither does the critic support his alteration with any reasons. Hist. an. 887.

SECTION XII.

Canary Bird.

Fringilla Canaria.—LINN.

THIS bird is of the finch tribe. It was originally peculiar to those isles to which it owes its name; the same that were known to the ancients by the addition of the *fortunate.* The happy temperament of the air; the spontaneous productions of the ground in the varieties of fruits; the sprightly and cheerful disposition of the inhabitants; and the harmony arising from the number of the birds found there, procured them that romantic distinction. Though the ancients celebrate the isle of *Canaria* for the multitude of birds, they have not mentioned any in particular. It is probable then, that our species was not introduced into Europe till after the second discovery of these isles, which was between the thirteenth and fourteenth centuries. We are uncertain when it first made its appearance, in this quarter of the globe. Belon, who wrote in 1555, is silent in respect to these birds: Gesner is the first who mentions them; and Aldrovandi speaks of them as rarities: that they were very dear on account of the difficulty attending the bringing them from so distant a country: and that they were purchased by people of rank alone. Olina says, that in his time there was a degenerate sort found on the isle of Elba, off the coast of Italy, which came there originally by means of a ship bound from the Canaries to Leghorn, and was wrecked on that island. We once saw some small birds brought directly from the Canary islands, that we suspect to be the genuine sort; they were of a dull green colour; but as they did not sing, we supposed them to be hens. These birds will produce with the goldfinch and linnet, and the offspring is called a mule bird; because, like that animal, it proves barren.

They are still found on the same spot to which we were first indebted for the productions of such charming songsters; but they are now become so numerous in our country, that we are under no necessity of crossing the ocean for them.

[*Pennant.*

SECTION XIII.

Sky Lark.

Alauda arvensis.—LINN.

THE length of this species is seven inches, one-fourth; the breadth twelve and a-half; the tongue broad and cloven; the bill slender; the under mandible dusky, the lower yellow; above the eyes is a yellow spot; the crown of the head a reddish brown, spotted with deep black; the hind part of the head ash-colour; chin white. It has the faculty of erecting the feathers of the head. The feather on the back, and coverts of the wings, dusky, edged with reddish brown, which is paler on the latter; the quill-feathers dusky; the exterior web edged with white, that of the others with reddish brown, the upper part of the breast yellow, spotted with black; the lower part of the body of a pale yellow; the exterior web, and half of the interior web, next to the shaft of the first feather of the tail, are white; of the second only the exterior web; the rest of those feathers dusky; the others are dusky, edged with red; those in the middle deeply so, the rest very slightly; the legs dusky; soles of the feet yellow; the hind claw very long and strait.

This and the wood-lark are the only birds that sing as they fly; this raising its note as it soars, and lowering it till it quite dies away as it descends. It will often soar to such a height, that we are charmed with the music when we lose sight of the songster; it also begins its song before the earliest dawn. Milton, in his Allegro, most beautifully expresses these circumstances; and Bishop Newton observes, that the beautiful scene that Milton exhibits of rural cheerfulness, at the same time gives us a fine picture of the regularity of his life, and the innocency of his own mind; thus he describes himself as in a situation

To hear the lark begin his flight,
And singing startle the dull night,
From his watch tower, in the skies,
'Till the dappled dawn doth rise.

It continues its harmony several months, beginning early in the spring, on pairing. In the winter they assemble in vast flocks,

grow very fat, and are taken in great numbers for our tables. They build their nest on the ground, beneath some clod, forming it of hay, dry fibres, &c. and lay four or five eggs.

The place these birds are taken in the greatest quantity, is the neighbourhood of Dunstable; the season begins about the 14th of September, and ends the 25th of February: and during that space about 4000 dozen are caught, which supply the market of the metropolis. Those caught in the day, are taken in clap-nets of fifteen yards length, and two and a-half in breadth; and are enticed within their reach by means of bits of looking-glass, fixed in a piece of wood, and placed in the middle of the nets, which, are put in a quick whirling motion, by a string the larker commands: he also makes use of a decoy lark. These nets are used only till the 14th of November, for the larks will not *dare*, or frolick in the air, except in fine sunny weather; and of course cannot be inveigled into the snare. When the weather grows gloomy, the larker changes his engine, and makes use of a trammel-net, twenty-seven or twenty-eight feet long, and five broad; which is put on two poles, eighteen feet long, and carried by men under each arm, who pass over the fields and quarter the ground as a setting dog; when they hear or feel a lark hit the net, they drop it down, and so the birds are taken.

[*Pennant.*

SECTION XIV.

Nightingale.

Motacilla luscinia.—Linn.

The nightingale takes its name from *night*, and the Saxon word *galan*, to sing; expressive of the time of its melody. In size it is equal to the redstart; but longer bodied, and more elegantly made. The colours are very plain. The head and back are of a pale tawny, dashed with olive; the tail is of a deep tawny red; the throat, breast, and upper part of the belly, of a light glossy ash-colour: the lower belly almost white; the exterior web of the quill-feathers are of a dull reddish brown; the interior of brownish ash-colour: the irides are hazel, and the eyes remarkably large and piercing; the legs and feet a deep ash-colour.

This bird, the most famed of the feathered tribe, for the variety,

length, and sweetness of its notes, visits England the beginning of April, and leaves us in August. It is a species that does not spread itself over the island. It is not found in North Wales; or in any of the English counties north of it, except Yorkshire, where they are met with in great plenty about Doncaster. They have been also heard, but rarely, near Shrewsbury. It is also remarkable, that this bird does not migrate so far west as Devonshire and Cornwall; counties where the seasons are so very mild, that myrtles flourish in the open air during the whole year: neither are they found in Ireland. Sibbald places them in his list of Scotch birds; but they certainly are unknown in that part of Great Britain, probably from the scarcity and the recent introduction of hedges there. Yet they visit Sweden, a much more severe climate. With us they frequent thick hedges, and low coppices; and generally keep in the middle of the bush, so that they are very rarely seen. They form their nest of oak-leaves, a few bents, and reeds. The eggs are of a deep brown. When the young first come abroad, and are helpless, the old birds make a plaintive and jarring noise, with a sort of snapping, as if in menace, pursuing along the edge the passengers.

They begin their song in the evening, and continue it the whole night. These their vigils did not pass unnoticed by the ancients; the slumbers of these birds were proverbial; and not to rest as much as the nightingale expressed a very bad sleeper*. This was the favourite bird of the British poet, who omits no opportunity of introducing it, and almost constantly noting its love of solitude and night. How finely does it serve to compose part of the solemn scenery of his Penseroso, when he describes it.

In her saddest sweetest plight,
Smoothing the rugged brow of night;
While Cynthia checks her dragon yoke,
Gently o'er the accustom'd oak;
Sweet bird, that shunn'st the noise of folly,
Most musical, most melancholy!
Thee, chauntress, oft the woods among,
I woo to hear thy evening song.

* Ælian Var. Hist. 577, both in the text and note. It must be remarked, that nightingales sing also in the day.

In another place he styles it the *solemn bird:* and again speaks of it,

> As the wakeful bird,
> Sings darkling, and in shadiest covert hid,
> Tunes her nocturnal note.

The reader must excuse a few more quotations from the same poet, on the same subject; the first describes the approach of evening, and the retiring of all animals to their repose:

> Silence accompanied; for beast and bird,
> They to their grassy couch, these to their nests,
> Were slunk; all but the wakeful nightingale.
> She all night long her amorous descant sung.

When Eve passed the irksome night preceding her fall, she, in a dream, imagines herself thus reproached with losing the beauties of the night, by indulging too long a repose:

> Why sleep'st thou, Eve? now is the pleasant time
> The cool, the silent, save where silence yields
> To the night-warbling bird, that now awake,
> Tunes sweetest his love-labour'd song.

The same birds sing their nuptial song, and lull them to rest. How rapturous are the following lines! how expressive of the delicate sensibility of our Milton's tender ideas!

> The earth
> Gave sign of gratulation, and each hill;
> Joyous the birds: fresh gales and gentle airs,
> Whisper'd it to the woods, and from their wings
> Flung rose, flung odours from the spicy shrub,
> Disporting, till the amorous bird of night
> Sung spousal, and bid haste the evening star,
> On his hill top to light the bridal lamp.

> These lull'd by nightingales, embracing slept;
> And on their naked limbs the flowery roof
> Shower'd roses, which the morn repair'd.

These quotations from the best judge of melody, we thought due to the sweetest of our feathered choristers; and we believe no reader of taste will think them tedious.

Virgil seems to be the only poet, among the ancients, who hath attended to the circumstance of this bird's singing in the night time.

> Qualis populeâ mœrens Philomela sub umbrâ
> Amissos queritur fœtus, quos durus arator
> Observans nido implumles detraxit: at illa
> Flet noctem, ramoque sedens miserabile carmen
> Integrat, et mœstis late loco questibus implet.
>
> Georg. IV. l. 511.

> As Philomel in poplar shades, alone,
> For her lost offspring pours a mother's moan,
> Which some rough ploughman marking for his prey,
> From the warm nest, unfledg'd hath dragg'd away;
> Percht on a bough, she all night long complains,
> And fills the grove with sad repeated strains.
>
> F. Warton.

Pliny has described the warbling notes of this bird, with an elegance that bespeaks an exquisite sensibility of taste; notwithstanding that his words have been cited by most other writers on natural history, yet such is the beauty, and in general the truth of his expressions, that they cannot be too much studied by lovers of natural history. We must observe notwithstanding, that a few of his thoughts are more to be admired for their vivacity, than for strict philosophical reasoning: but these few are easily distinguishable. [*Pennant.*

SECTION XV.

Red Breast.

Motacilla rubecola.—Linn.

This bird, though so very petulant as to be at constant war with its own tribe, yet is remarkably social with mankind; in the winter it frequently makes one of the family; and takes refuge from

the inclemency of the season even by our fire-sides. Thomson* has prettily described the annual visits of this guest;

> The red-breast, sacred to the household gods,
> Wisely regardful of the embroiling sky,
> In joyless fields, and thorny thickets, leaves
> His shivering mates, and pays to trusted man
> His annual visit. Half afraid, he first
> Against the window beats; then, brisk, alights
> On the warm earth; then hopping o'er the floor
> Eyes all the smiling family askance,
> And pecks and starts, and wonders where he is:
> 'Till, more familiar grown, the table-crumbs
> Attract his slender feet.

The great beauty of that celebrated poet consists in his elegant and just descriptions of the œconomy of animals; and the happy use he hath made of natural knowledge in descriptive poetry, shines through almost every page of his Seasons. The affection this bird has for mankind, is also recorded in that ancient ballad, *The babes in the wood;* a composition of a most beautiful and pathetic simplicity. It is the first trial of our humanity; the child that refrains from tears on hearing that read, gives but a bad presage of the tenderness of his future sensations.

In the spring this bird retires to breed in the thickest coverts, or the most concealed holes of walls and other buildings. The eggs are of a dull white, sprinkled with reddish spots. Its song is remarkably fine and soft: and the more to be valued, as we enjoy it the greatest part of the winter, and early in the spring, and even through great part of the summer; but its notes are part of that time drowned in the general warble of the season. Many of the autumnal songsters seem to be the young cock red breasts of that year.

The bill is dusky; the forehead, chin, throat, and breasts are of a deep orange-colour: the head, hind part of the neck, the back, and tail, are of a deep ash-colour, tinged with green: the wings rather darker; the edges inclining to yellow; the legs and feet dusky. [*Pennant.*

* In his Seasons, vide Winter, line 246.

SECTION XVI.

Wren.

Motacilla troglodytes.—LINN.

THE wren may be placed among the finest of our singing birds. It continues its song throughout the winter, excepting during the frosts. It makes its nest in a very curious manner; of an oval shape, very deep, with a small hole in the middle for egress and regress; the external material is moss, within it is lined with hair and feathers. It lays from ten to eighteen eggs; and as often brings up as many young; which, as Mr. Ray observes, may be ranked among those daily miracles that we take no notice of; that it should feed such a number without passing over one, and that too in utter darkness.

The head and upper part of the body of the wren are of a deep reddish brown; above each eye is a stroke of white; the back, and coverts of the wings, and tail, are marked with slender transverse black lines; the quill feathers with bars of black and red. The throat is of a yellowish white. The belly and sides crossed with narrow dusky and pale reddish brown lines. The tail is crossed with dusky bars. [*Pennant.*

SECTION XVII.

Swift.

Hirundo apus.—LINN.

THIS species is the largest of our swallows; but the weight is most disproportionately small to its extent of wing of any bird; the former being scarce one ounce, the latter eighteen inches; the length near eight. The feet of this bird are so small, that the action of walking and of rising from the ground is extremely difficult; so that nature hath made it full amends, by furnishing it with ample means for an easy and continual flight. It is more on the wing than any other swallows: its flight is more rapid, and that attended with a shrill scream. It rests by clinging against some wall or other apt body; from whence Klein styles this species *hirundo muraria.* It breeds under the caves of houses, in steeples, and other lofty buildings; makes its nest of grasses and

feathers; and lays only two eggs, of a white colour. It is entirely of a glossy dark sooty colour, only the chin is marked with a white spot; but by being so constantly exposed to all weathers, the gloss of the plumage is lost before it retires. I cannot trace them to their winter quarters, unless in one instance of a pair found adhering by their claws, and in a torpid state, in February, 1766, under the roof of Longnor chapel, Shropshire; on being brought to a fire, they revived and moved about the room. The feet are of a particular structure, all the toes standing forward; the least consists of only one bone; the others of an equal number, viz. two each; in which they differ from those of all other birds.

This appears in our country about fourteen days later than the sand martin, but differs greatly in the time of its departure, retiring invariably about the tenth of August, being the first of the genus that leaves us.

The fabulous history of the Manucodiata, or bird of Paradise, is in the history of this species in great measure verified. It was believed to have no feet, to live upon the celestial dew, to float perpetually on the Indian air, and to perform all its functions in that element.

The swift actually performs what has been in these enlightened times disproved of the former: except the small time it takes in sleeping, and what it devotes to incubation, every other action is done on wing. The materials of its nest it collects either as they are carried about by the winds, or picks them up from the surface in its sweeping flight. Its food is undeniably the insects that fill the air. Its drink is taken in transient sips from the water's surface. Even its amorous rites are performed on high. Few persons who have attended to them in a fine summer's morning, but must have seen them make their aërial courses at a great height, encircling a certain space with an easy steady motion. On a sudden they fall into each other's embraces, then drop precipitate with a loud shriek for numbers of yards. This is the critical conjuncture, and to be no more wondered at, than that insects (a familiar instance) should discharge the same duty in the same element.

These birds and swallows are inveterate enemies to hawks. The moment one appears, they attack him immediately; the swifts soon desist; but the swallows pursue and persecute those rapacious birds, till they have entirely driven them away.

Swifts delight in sultry thundry weather, and seem thence to receive fresh spirits. They fly in those times in small parties with particular violence; and as they pass near steeples, towers, or any edifice where their mates perform the office of incubation, emit a loud scream, a sort of serenade, as Mr. White supposes, to their respective females.

[*Pennant.*

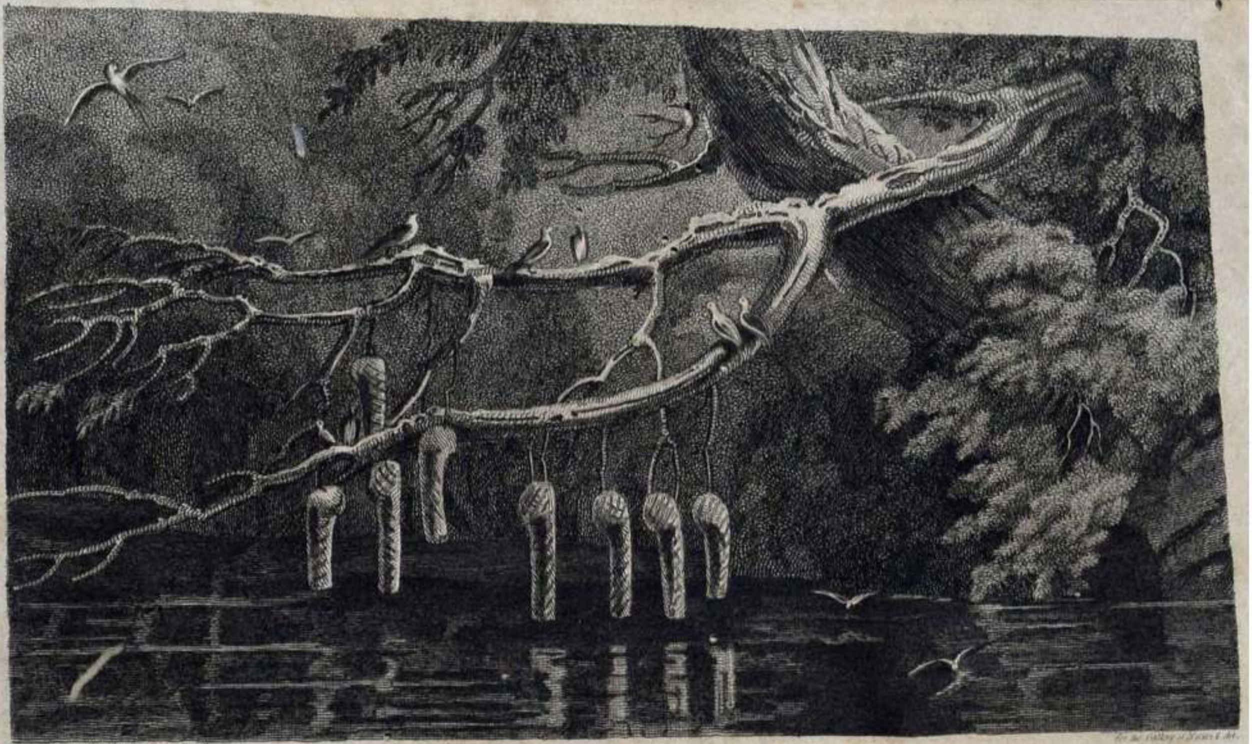
SECTION XVIII.

On the Migration of Birds.

It is believed that many different kind of birds annually pass from one country to another, and spend the summer or the winter where it is most agreeable to them; and that even the birds of our own island will seek the most distant southern regions of Africa, when directed by a peculiar instinct to leave their own country. It has long been an opinion pretty generally received, that swallows reside during the winter-season, in the warm southern regions; and Mr. Adanson particularly relates his having seen them at Senegal, when they were obliged to leave this country. But besides the swallow, Mr. Pennant enumerates many other birds which migrate from Britain at different times of the year, and are then to be found in other countries; after which they again leave these countries, and return to Britain. The reason of these migrations he supposes to be a defect of food at certain seasons of the year, or a want of a secure asylum from the persecution of man during the time of courtship, incubation, and nutrition. The following is his list of the migrating species.

1. Crows.—Of this genus, the hooded crow migrates regularly with the woodcock. It inhabits North Britain the whole year; a few are said annually to breed on Dartmoor, in Devonshire. It breeds also in Sweden and Austria: in some of the Swedish provinces it only shifts its quarters, in others it resides throughout the year. Every ornithologist is at a loss for the summer retreat of those which visit us in such numbers in winter, and quit our country in the spring; and for the reason why a bird, whose food is such that it may be found at all seasons in this country should leave us.

2. Cuckoo.—Disappears early in autumn; the retreat of this and the following bird is quite unknown to us.



Engraved by Dodd from a Drawing by Clennell.

AFRICAN BIRDS' NESTS.

3. Wryneck.—Is a bird that leaves us in the winter. If its diet be ants alone, as several assert, the cause of its migration is very evident. This bird disappears before winter, and revisits us in the spring, a little earlier than the cuckoo.

4. Hoopoe.—Comes to England but by accident: Mr. Pennant once indeed heard of a pair that attempted to make their nest in a meadow at Selborne, Hampshire, but were frightened away by the curiosity of people. It breeds in Germany.

5. Grous.—The whole tribe, except the quail, lives here all the year round; that bird either leaves us, or else retires towards the sea-coasts.

6. Pigeons.—Some few of the ring-doves breed here; but the multitude that appears in the winter is so disproportioned to what continue here the whole year, as to make it certain that the greatest part quit the country in the spring. It is most probable they go to Sweden to breed, and return from thence in autumn; as Mr. Eckmark informs us, they entirely quit that country before winter. Multitudes of the common wild pigeons also make the northern retreat, and visit us in winter; not but numbers breed in the high cliffs in all parts of this island. The turtle also probably leaves us in the winter, at least changes its place, removing to the southern counties.

7. Stare.—Breeds here. Possibly several remove to other countries for that purpose, since the produce of those that continue here seems unequal to the clouds of them that appear in the winter. It is not unlikely that many of them migrate into Sweden, where Mr. Berger observes they return in spring.

8. Thrushes.—The fieldfare and the redwing breed and pass their summers in Norway and other cold countries; their food is berries, which abounding in our kingdoms, tempt them here in the winter. These two, and the Royston crow, are the only land birds that regularly and constantly migrate into England, and do not breed here. The hawfinch and crossbill come here at such uncertain times as not to deserve the name of birds of passage.

9. Chatterer.—The chatterer appears annually about Edinburgh in flocks during winter, and feeds on the berries of the mountain ash. In South Britain, it is an accidental visitant.

10. Grosbeaks.—The grosbeak and crossbill come here but seldom; they breed in Austria. The pine grosbeak probably breeds in the forests of the highlands of Scotland.

11. Buntings.—All the genus inhabits England throughout the year, except the greater brambling, which is forced here from the north in very severe seasons.

12. Finches.—All continue in some parts of these kingdoms, except the siskin, which is an irregular visitant, said to come from Russia. The linnets shift their quarters, breeding in one part of this island, and remove with their young to others. All finches feed on the seeds of plants.

13. Larks, Fly-catchers, Wagtails and Warblers.—All of these feed on insects and worms; yet only part of them quit these kingdoms, though the reason of migration is the same to all. The nightingale, black-cap, fly-catcher, willow-wren, wheat-ear, and white-throat, leave us before winter, while the small and delicate golden-crested wren braves our severest frosts. The migrants of this genus continue longest in Great Britain in the southern counties, the winter in those parts being later than in those of the north; Mr. Stillingfleet having observed several wheat-ears in the isle of Purbeck, on the 18th of November. As these birds are incapable of very distant flights, Spain, or the south of France, is probably their winter asylum.

14. Swallows and Goat-suckers.—Every species disappears at the approach of winter.

Water-Fowl.

Of the vast variety of water-fowl that frequent Great Britain, it is amazing to reflect how few are known to breed here: the cause that principally urges them to leave this country seems to be not merely the want of food, but the desire of a secure retreat. Our country is too populous for birds so shy and timid as the bulk of these are: when great part of our island was a mere waste, a tract of wood and fen, doubtless many species of birds (which at this time migrate) remained in security throughout the year. Egrets, a species of heron, now scarce known in this island, were in former times in prodigious plenty; and the crane, that has totally forsaken this country, bred familiarly in our marshes; their place of incubation, as well as of all other cloven-footed water-fowl (the heron excepted), being on the ground, and exposed to every one. As rural economy increased in this country, these animals were more and more disturbed; at length, by a series of alarms, they were necessitated to seek, during the summer, some lonely safe habitation.

On the contrary, those that build or lay in the almost inaccessible rocks that impend over the British seas, breed there still in vast numbers, having little to fear from the approach of mankind: the only disturbance they meet with in general, being from the desperate attempts of a few, to get their eggs.

Cloven-footed Water-Fowl.

15. Herons.—The white heron is an uncommon bird, and visits us at uncertain seasons; the common kind, and the bittern never leave us.

16. Curlews.—The curlew breeds sometimes on our mountains, but considering the vast flights that appear in winter, it is probable that the greater part retire to other countries: the whimbrel breeds on the Grampian hills, in the neighbourhood of Invercauld.

17. Snipes.—The woodcock breeds in the moist woods of Sweden, and other cold countries. Some snipes breed here, but the greatest part retire elsewhere; as do every other species of this genus.

18. Sandpipers.—The lapwing continues here the whole year; the ruff breeds here, but retires in winter; the redshank and sandpiper breed in this country, and reside here. All the others absent themselves during summer.

19. Plover and Oyster-catcher.—The long-legged plover and sanderling visit us only in winter; the dottrel appears in spring and in autumn; yet, what is very singular, we do not find it breeds in South Britain. The oyster-catcher lives with us the whole year. The Norfolk plover and sea-lark breed in England. The green plover breeds on the mountains of the north of England, and on the Grampian hills.

We must here remark, that every species of the genera of curlews, woodcocks, sandpipers, and plovers, that forsake us in the spring, retire to Sweden, Poland, Prussia, Norway, and Lapland, to breed: as soon as the young can fly, they return to us again, because the frosts which set in early in those countries, totally deprive them of the means of subsisting; as the dryness and hardness of the ground, in general, during our summer prevent them from penetrating the earth with their bills, in search of worms, which are the natural food of these birds. Mr. Eckmark speaks thus of the retreat of the whole tribe of cloven-footed water-fowl out of his country (Sweden) at the approach of winter; and

Mr. Klein gives much the same account of those of Poland and Prussia.

20. Rails and Gallinules.—Every species of these two genera continues with us the whole year; the land rail excepted, which is not seen here in winter. It likewise continues in Ireland only during the summer-months, when they are very numerous, as Mr. Smith tells us, in the History of Waterford, p. 336. Great numbers appear in Anglesea the latter end of May; it is supposed they pass over from Ireland, the passage between the two islands being but small. As we have instances of these birds lighting on ships in the Channel and the Bay of Biscay, we may conjecture their winter-quarters to be in Spain.

Fin-footed Water-Birds.

21. Phalaropes.—Visit us but seldom; their breeding-place is Lapland, and other arctic regions.

22. Grebes.—The great crested grebe, the black and white grebe, and the little grebe, breed with us, and never migrate; the others visit us accidentally, and breed in Lapland.

Web-footed Birds.

23. Avoset.—Breed near Fossdike, in Lincolnshire, but quit their quarters in winter. They are then shot in different parts of the kingdom, which they visit, not regularly but accidentally.

24. Auks and Guillemots.—The great auk or penguin sometimes breeds in St. Kilda. The auk, the guillemot, and puffin, inhabit most of the maritime cliffs of Great Britain, in amazing numbers during summer. The black guillemot breeds in the Bass Isle, and in St. Kilda, and sometimes in Llandidno rocks. We are at a loss for the breeding-place of the other species; neither can we be very certain of the winter residence of any of them, excepting of the lesser guillemot and black-billed auk, which, during winter, visit in vast flocks the Frith of Forth.

25. Divers.—These chiefly breed in the lakes of Sweden and Lapland, and in some countries near the pole; but some of the red-throated divers, the northern and the imber, may breed in the north of Scotland and its isles.

26. Terns.—Every species breeds here; but leaves us in the winter.

27. Petrels.—The fulmar breeds in the isle of St. Kilda, and continues there the whole year except September and part of October. The shearwater visits the Isle of Man in April; breeds there; and, leaving it in August or the beginning of September, disperses over all parts of the Atlantic ocean. The stormfinch, is seen at all distances from land, on the same vast watery tract; nor is ever found near the shore, except by some very rare accident, unless in the breeding season. Mr. Pennant found it on some little rocky isles on the north of Skye. It also breeds on St. Kilda: He also suspects that it nestles on the Blasquet Isles, off Kerry, and that it is the gourder of Mr. Smith.

28. Mergansers.—This whole genus is mentioned among the birds that fill the Lapland lakes during summer. Mr. Pennant has seen the young of the red-breasted in the north of Scotland: a few of these, and perhaps of the goosanders, may breed there.

29. Ducks.—Of the numerous species that form this genus, we know of few that breed here: the swan and goose, the shield-duck, the eider-duck, a few shovellers, garganies, and teals, and a very small portion of the wild ducks.

The rest contribute to form that amazing multitude of water-fowl that annually repairs from most parts of Europe to the woods and lakes of Lapland, and other arctic regions, there to perform the functions of incubation and nutrition in full security. They and their young quit their retreat in September, and disperse themselves over Europe. With us they make their appearance the beginning of October; circulate first round our shores; and, when compelled by severe frost, betake themselves to our lakes and rivers. Of the web-footed fowl, there are some of hardier constitutions than others: these endure the ordinary winters of the more northern countries; but when the cold reigns there with more than common rigour, they repair for shelter to these kingdoms: this regulates the appearance of some of the diver kind, as also of the wild swans, the swallow-tailed shield-duck, and the different sorts of goosanders which then visit our coasts. Barentz found the barnacles with their nests in great numbers in Nova Zembla. (Collect. Voy. Dutch East India Company, 8vo. 1703, p. 19.) Clusius, in his Exot. 368, also observes, that the Dutch discovered them on the rocks of that country, and in Waygait Straits. They, as well as the other species of wild geese, go very far north to breed, as appears from the histories of Greenland and Spitzbergen, by Egede

and Crantz. These birds seem to make Iceland a resting-place, as Horrebow observes: a few continue there to breed, but only visit that island in the spring, and after a short stay, retire still further north.

30. Corvorants.—The corvorant and shag breed on most of our high rocks; the gannet in some of the Scotch isles, and on the coast of Kerry; the two first continue on our shores the whole year. The gannet disperses itself all round the seas of Great Britain, in pursuit of the herring and pilchard, and even as far as the Tagus, to prey on the sardina.

But of the numerous species of fowl here enumerated, it may be observed how very few entrust themselves to us in the breeding season, and what a distant flight they make to perform the first great dictate of nature.

There seems to be scarcely any but what we have traced to Lapland, a country of lakes, rivers, swamps, and alps, covered with thick and gloomy forests, that afford shelter during summer to these fowls, which in winter disperse over the greatest part of Europe. In those arctic regions, by reason of the thickness of the woods, the ground remains moist and penetrable to the woodcocks, and other slender-billed fowl; and for the web-footed birds, the waters afford larves innumerable of the tormenting gnat. The days there are long; and the beautiful meteorous nights indulge them with every opportunity of collecting so minute a food, whilst mankind is very sparingly scattered over that vast northern waste.

Why then should Linnæus, the great explorer of these rude deserts, be amazed at the myriads of water-fowl that migrated with him out of Lapland? which exceeded in multitude the army of Xerxes; covering for eight whole days and nights, the surface of the river Calix! His partial observation as a botanist, would confine their food to the vegetable kingdom, almost denied tothe Lapland waters; inattentive to a more plenteous table of insect food, which the all-bountiful Creator had spread for them in the wilderness. It may be remarked, that the lakes of mountainous rocky countries in general, are destitute of plants: few or none are seen on those of Switzerland; and Linnæus makes the same observation in respect to those of Lapland, having during his whole tour, discovered only a single specimen of a lemma trisulca, or ivy-leaved duck's meat, Flora Lap. No. 470; a few of the scirpus lacustris, or bullrush, No. 18; the alopecurus geniculatus, or flote foxtail

grass, No. 38; and the ranunculus aquatilis, No. 234; which are all he enumerates in his Prolegomena to that excellent performance.

[*Pantologia. Barrington.*

CHAP. VII.

QUADRUPEDS AND OTHER ANIMALS THAT SUCKLE THEIR YOUNG.

Mammalia.—LINN.

SECTION I.

Orang-Otang.

Simia Troglodytes.—LINN.

OF these singular animals, the species which has most excited the attention of mankind is the orang-otang; or, as it is sometimes called, the satyr, great ape, or man of the woods. It is a native of the warmer parts of Africa and India, as well as of some of the Indian islands, where it resides principally in woods, and is supposed to feed, like most others of this genus, on fruits. The orang-otang appears to admit of considerable variety in point of colour, size, and proportions; and there is reason to believe, that, in reality, there may be two or three kinds, which, though nearly approximated as to general similitude, are yet specifically distinct. The specimens imported into Europe have rarely exceeded the height of two or three feet, and were supposed to be young animals; but it is said that the full-grown ones are, at least, six feet in height. The general colour seems to be dusky or brown; in some ferruginous or reddish brown, and in others coal-black, with the skin itself white. The face is bare; the ears, hands, and feet nearly similar to the human, and the whole appearance such as to exhibit the most striking approximation to the human figure. The likeness, however, is only a general one, and the structure of the hands and feet, when examined with anatomical exactness, seems to prove, in the opinion of those most capable of judging with accuracy on the subject, that the animal was principally designed by

nature for the quadrupedal manner of walking, and not for an upright posture, which is only occasionally assumed, and which, in those exhibited to the public, is, perhaps, rather owing to instruction than truly natural. The Count de Buffon, indeed, makes it one of the distinctive characters of the real or proper apes (among which the orang-otang is the chief), to walk erect on two legs only; and it must be granted, that these animals support an upright position much more easily and readily than most other quadrupeds, and may probably be very often seen in this attitude even in a state of nature.

The manners of the orang-otang, when in captivity, are gentle, and perfectly void of that disgusting ferocity so conspicuous in some of the larger baboons and monkies. The orang-otang is mild and docile, and may be taught to perform, with dexterity, a variety of actions in domestic life. Thus it has been seen sitting at table, and, in its manner of feeding and general behaviour, to imitate the company in which it was placed: to pour out tea, and drink it without aukwardness or constraint; to prepare its bed with exactness, and compose itself to sleep in a proper manner. Such are the actions recorded of one which was exhibited in London, in the year 1738; and the Count de Buffon relates nearly similar particulars of that which he saw at Paris. Dr. Tyson, who, about the close of the last century, gave a very exact descripton of a young orang-otang, then exhibited in the metropolis, assures us, that, in many of its actions, it seemed to display a very high degree of sagacity, and was of a disposition uncommonly gentle; "the most gentle and loving creature that could be. Those that he knew a ship-board he would come and embrace with the greatest tenderness, opening their bosoms, and clasping his hands about them; and, as I was informed, though there were monkies aboard, yet it was observed he would never associate with them, and, as if nothing akin to them, would always avoid their company."

But however docile and gentle when taken young, and instructed in its behaviour, it is said to be possessed of great ferocity in its native state, and is considered as a dangerous animal, capable of readily overpowering the strongest man. Its swiftness is equal to its strength, and for this reason it is but rarely to be obtained in its full-grown state; the young alone being taken.

[*Shaw*.

SECTION II.

Preacher Monkey.

Simia Beelzebub.—LINN.

THE size of this animal is that of a fox; with black shining eyes, short round ears, and round beard: hair on the body shining black, long, yet so close that the animal appears quite smooth; feet and end of the tail brown; tail very long, and always twisted at the end.

Singular as the name preacher, applied to a species of monkeys, may appear, their history is no less so; and were it not supported by good authority, it would seem quite fabulous. Several other authors corroborate the evidence of Marcgraave, a writer of the first authority, and a most able naturalist, who resided long in the Brazils where these creatures abound. He speaks from his own knowledge, and tells us, that morning and evening they assemble in the woods; that one mounts on a higher branch, while the rest seat themselves beneath; that when he perceives them all seated, he begins, as if it were to harangue, and sets up so loud and sharp a howl that a person at a distance would think a hundred joined in the cry; the rest, however, keep the most profound silence, till he stops and gives a signal with his hand; then, in an instant the whole assembly join in chorus, till he commands silence by another signal, which they obey in a moment; then the orator resumes his discourse, and finishes his address, and the assembly breaks up. Their clamour is the most disagreeable and tremendous that can be conceived; this faculty proceeds from the peculiar conformation of a hollow and hard bone placed in the throat, and called the throat bone or os hyoides. These monkeys are very fierce, quite untameable, and bite dreadfully; though not carnivorous, they excite terror by their frightful voice and ferocious aspect. The female is of the same colour with the male, and differs from him only in being smaller; the females carry their young on their back, and leap with them from branch to branch, and from tree to tree; the young embrace, with their hands and arms, the body of the mother, and remain firmly fixed as long as she is in motion; when she wants to suckle, she takes the young in her paws and presents the breast to it, like a human wet nurse. There is no method of obtaining the young one,

but by killing the mother; for she never abandons it. When she is killed, it falls from her, and may be seized.

As they feed only on fruits, pot-herbs, grain, and some insects, their flesh is reckoned not bad eating. It resembles mutton, or the flesh of a hare. One of them is a meal for six persons. They are the most common game, and the most agreeable to the taste of the Amazon Indians; they roast one part, and boil the other: "We lived upon them," says a French writer, "during all the time we remained there, because we could procure no other food; and the hunters supplied us daily with as many as we could eat. I went to see this species of hunting, and was surprised at the sagacity of these animals, not only in distinguishing particularly those who make war upon them, but also in defending themselves, and providing for their own safety when attacked. When we approached, they all assembled together, uttered loud and frightful cries, and threw at us dried branches which they broke off from the trees. I likewise remarked, that they never abandon one another; that they leap from tree to tree with incredible agility; and fling themselves headlong from branch to branch, without ever falling to the ground; because, before reaching the earth, they always catch hold of a branch, either with their hands or tail; so that if not shot dead at once, they cannot be seized; for, even when mortally wounded, they remain fixed to the trees, where they often die, and fall not off till corrupted. Fifteen or sixteen of them are frequently shot, before three or four of them can be obtained. What is singular, as soon as one is wounded, the rest collect about him, and put their fingers into the wound, as if they meant to sound it; and when it discharges much blood, some of them keep the wound shut, while others make a mash of leaves, and dexterously close the aperture. This operation I have often observed with much wonder." "After I have shot at one," says Dampier, "and broke a leg or an arm, I have often pitied the poor creature, to see it look at and handle the wounded limb, and turn it about from side to side." When the savages shoot them with arrows, they extract the arrow out of their bodies with their own hands, like human creatures.

When these creatures are embarrassed, they assist each other in passing a brook, or getting from one tree to another.

[*Margraave. Pantologia.*

SECTION III.

Elephant; with a Description of the Elephant Hunt.

THE TANTO... MAHAL.

Elephas maximus.—LINN.

THIS is the only known species of the genus: it is the largest of quadrupeds, sometimes weighing four thousand five hundred pounds; body cinereous, seldom reddish or white, thinly set with hairs; proboscis flat beneath, tip truncate; eyes small; tusks, which are only in the upper jaw, far extended beyond the mouth, resembling horns, marked with curled fibres, constituting the ivory of the shops, and sometimes weighing a hundred and fifty pounds each; ears large, pendulous, dentate; skin thick, callous, impenetrable by musket balls, and yet sensible of the sting of flies; teats two, near the breast; knees flexible; neck short; hoofs five on each fore-foot, four on each hind-foot.

Some writers have made the sukotyro a second species of the elephant, but incorrectly. He has a distinguishing property that ought to constitute him a distinct genus.

The elephant inhabits the torrid zone, in swampy places, and by the sides of rivers; feeds on the leaves and branches of young trees, particularly plaintains, eating even the wood; devours grain voraciously; is gregarious, docile, long-lived, and sagacious, though the brain is small; hereby confuting the doctrine of those philosophers, who contend that the intellect possessed depends upon the size of the brain compared with the size of the animal; drawing their doctrine from the human form and human brain alone.

The proboscis is long, extensile, contractile; furnished at the end with a hook, serving the purpose of a hand, with which it takes its food and drink; and which being cut off, the animal perishes. He is afraid of mice, lest when he sleeps they should creep into his trachea; urines backwards; copulates like other quadrupeds. The female is gravid a year; the young suck the mother with their lips. Carries houses on his back, his guider sitting upon the neck; moves quickly; swims dextrously; is armed for war by the natives of India; and was formerly armed by the Romans with scythes. The contrivances for taking wild elephants are various: the two most common are decoying them into places of security by means of female elephants properly instructed; and hunting or rather fright-

ening them forwards, from one part of the wood to another, till they reach the place of their imprisonment, which is strongly pallisadoed all round, with a view of escaping from the noise, and torches employed on such occasions. When once they are caught, they are easily tamed, by observing the submission of other elephants.

The Ceylonese elephants are those most highly esteemed in India; and the mode of snaring them is peculiarly entertaining and curious. In Mr. Cordiner's Description of Ceylon, there is a good account of this extroradinary decoy, and we shall present our readers with it, in as condensed a form as possible. The hunt alluded to, took place near the elephant snare at Kotaway, only a few miles distant from Tengalle. The governor and his suite attended on this occasion, and the whole of the party employed was not fewer than three thousand persons. The whole of this multitude surrounded the forests in which elephants are discovered to abound, with a chain of fires placed on moveable stands, so as to be brought closer, according as the elephants are driven nearer to the centre. The distance between the fires may at first have been an hundred paces, which is gradually reduced to about ten paces. The more the elephants are confined, the more vigilant the hunters must become, and prepared to repel their efforts to escape, by advancing the fires, and by loud shouting. At the end of two months, they thus become inclosed in a circle, of which the wide entrance of the snare forms a part, and are at last brought so near to it, that by the exertions of the surrounding multitude, they can be made close prisoners in a few hours. It is now that all those who are desirous of witnessing the capture resort to the scene of action.

An idea of the enclosure may be formed by drawing, on a piece of paper, the outline of a wide funnel. A little way within the wide end, a palisade runs across, in breadth six hundred feet, containing four open gates, which the elephants enter. A view of two of these is commanded from a bungaloe, erected for spectators on pillars thirty feet from the ground. The enclosure is formed of the strongest trees on the island, from eight to ten inches in diameter, bending inwards, sunk four feet into the ground, and from sixteen to twenty feet high above it. They are placed at the distance of sixteen inches from each other, and crossed by four rows of powerful beams, bound fast to them by pliant canes. To this palisade are added supporters more inclined, several feet asunder,

Engraved by [illegible], from a Drawing by [illegible]

For the Gallery of Nature & Art.

AN ELEPHANT HUNT.

augmenting the strength of the fence. The part of it in which the elephants are first enclosed, is eighteen hundred feet in circumference; but it communicates with a smaller fold, one hundred feet in length, and forty broad, through which a rivulet passes, five feet in depth, and nearly fills the enclosure. The elephants enter this place of confinement at only one gate; and beyond the water the fence gradually contracts, terminating in a strong passage, five feet broad, and one hundred feet long.

We give likewise, in our author's own words, the striking picture of the entrance of the elephants into the first snare.

"All things being ready for driving the elephants into the snare, the governor and his party repaired to the ground about seven o'clock in the evening, ascended the elevated bungaloe by a long ladder, and waited several dark and tedious hours; but the termination of the chase amply repaid their patience. It was necessary that silence, as well as darkness, should reign amongst us; and, in a situation where our eyes and ears were otherwise so attentively engaged, conversation would be particularly irksome. The shouting of the hunters was incessant, muskets and rockets joined in the chorus, and the wild roaring of the elephants was heard at intervals, more distinctly warning us of their approach. At length the forest crashed, and the enormous herd pushed forward with fury, levelling instantaneously every tree which opposed their passage. The following up of the people with the lights and fire-works was truly grand. Every man waved in his hand a blazing torch, formed of a bundle of reeds, the feeble but effectual means of defence against a tremendous foe. The trees were nobly illuminated, and, towering aloft amidst the surrounding darkness, spread their glittering foliage in the air."

When the first enclosure is completely stocked, the four gates are closed, and secured with strong stakes. Then another chain of fire and torches is formed within the enclosure, and the persecuted animals are driven forward in like manner into the smaller fold.

"The line of flame once more began its terrifying movement. The people resumed their tumultuous noise, mingled with the din of trumpets, drums, and arms. The affrighted herd, again annoyed with impending horrors, renewed their tremendous flight; and rushing like an agitated torrent into the water snare, experienced still greater sorrows. As soon as seventy elephants had found

their way into this place, it being sufficiently crammed, the cords were cut, and the barricading gate dropped down. The greater part of those which had entered were so closely wedged together, that many of them were motionless; and even the foremost, which were less confined, saw only a fallacious opening to lead them from this doleful labyrinth. Upwards of one hundred of the captured herd, cut off from their companions, were left for a time to range at greater liberty in the larger prison."

All this took place during the night.

"At sunrise," continues Mr. Cordiner, "we became spectators of a most extraordinary sight. So great a number of enormous animals crowded into so small a compass, is a spectacle rarely to be seen. Pressing heavily upon one another, incapable of almost any movement but convulsions of distress, their paroxyisms of anguish could not be contemplated without emotion. No person could find language to express his feelings. All were struck dumb with a species of astonishment hitherto unexperienced. The most hazardous part of the business remains, that of seizing on the elephants at the end of the long passage, which is the only outlet from the water snare. They are driven in one by one, making furious efforts to regain their liberty on finding themselves prisoners. When they reach the gate at the end, strong beams are inserted across the passage behind, to prevent them from retreating. Men then approach, and bind their hind legs with great ropes, and five or six turns of smaller cordage are passed round their necks. While these operations are going on, a man stands before the gate of the passage, tickling the elephant's trunk, and diverting his attention. In this manner they are secured, yet accidents frequently happen at this time. On the present occasion, one unfortunate man tumbled into the passage, and was instantly trampled to death under the feet of an enraged elephant. They frequently press against one another in the water snare, and the passage, with so much violence, that some are squeezed to death, or drop down dead with fatigue."

When the wild elephant is completely harnessed, two tame elephants, trained to the business, are brought to the gate, and placed one on each side of it. These immediately survey the prisoner whom they have to conduct, feel his mouth to know whether he has tusks or not, and lay hold of his proboscis to ascertain what degree of resistance he is likely to make. Ropes are passed through the collar of the wild elephant, and made fast to similar collars on

each side of the tame ones. The bars of the gate are then unloosed, and drawn out; and the wild captive darts forward directly between the two tame elephants: he can, however, only advance a little way, as the ropes securing his hind legs still continue fastened to the strong stakes of the toil. In this situation he remains, until the riders mounted on the tame elephants have drawn *tight* the cords, which bind him to the necks of his half reasoning conductors.

During this operation, he endeavours to undo with his trunk some of the knots which have been made, and often attempts to give a destructive blow to the diminutive creatures so actively engaged in confirming his captivity. But the two tame *animals*, who are vigilantly observant of all his motions, never *fail to* prevent him from doing any mischief, by *gently* lowering his proboscis with their own: if he continue *long refractory*, they batter him with their heads, and at *last* produce the most obsequious submission. The nooses of the ropes are then opened, leaving his hind legs at freedom, and himself entirely disengaged from the snare. The two tame elephants press close on each side of him, and proceed, in pompous procession, to the garden of stalls, where they deliver up their charge to experience another species of hardships. The marching off of this venerable trio is a sight truly magnificent, and exhibits a noble specimen of the skill of man, united with the sagacity of the elephant.

In this manner the prisoner is conducted to a grove, where, if he is of an ordinary size, he is sufficiently secured by being placed lengthways between two trees, to one of which his hind legs are bound, and one of his fore legs to the other. A more complicated apparatus of ropes and stakes is necessary for those which are remarkable for strength and fury. The tame conductors then move away to secure another captive. An elephant may frequently be tamed in eight or ten days, though in other instances months are required. When tamed, they are marched round to Jaffnapatam, there sold by public auction, and thence exported to the opposite continent.

[*Pantologia.*

SECTION IV.

Manate or Manati.

Trichecus manatus.—LINN.

THIS curious quadruped is of the same genus as the morse, sea-horse, or sea-cow; and has probably given rise to the fable of *mermen* and *mermaids*. The species includes three varieties, the whale-tailed, mud-tailed, and siren, or sea-ape.

The fore-feet of the first, or whale-tailed manate, are little more than pectoral fins; they serve only for swimming, and are never used for walking; for it never goes ashore like the walrus and seal. It brings forth in the water, and, like the whale, suckles its young in that element. Like the whale too, it has a horizontal broad tail, without even the rudiments of hind feet. It inhabits the north-west coast of America, African, and American seas.

They live perpetually in the water, and frequent the edges of the shores. In calm weather they swim in great droves near the mouths of rivers. In the time of flood they come so near the land, that a person may stroke them with his hand. They live in families, near each other; each family consists of a male, a female, a half grown young one, and a very small one. The females oblige their young to swim before them, while the other old ones surround and guard them on all sides. The affection between male and female is very great; for if she be attacked, he will defend her to the utmost; and, if she be killed, will follow her corps to the very shore, and swim some days near the place it has been landed at. They copulate in the spring; the female brings but one young one at a time, and suckles it by two teats. They are extremely voracious, and when filled, fall asleep on their backs. During their meals they are so intent on their food, generally sea-weeds, that any one may go among them, and choose which he likes best.

Their backs and sides are generally above water; and numbers of gulls are continually perching on them, and picking out a peculiar species of louse, with which their skins are infested. In winter they are so very lean, that we may count their ribs. When struck with a harpoon, it requires the united strength of thirty men to draw, one of them ashore. When a manata is struck, its companions swim to its asssistance; some attempt to overturn the boat, others press

down the rope to break it, and others strike at the harpoon with their tails, and often succeed in forcing it out.

They are of an enormous size; some are twenty-three feet long, and weigh 8,000 pounds. The head is small, oblong, and almost square; the nostrils are filled with short bristles; the gape is small; the lips double; near the junction of the two jaws the mouth is full of white tubular bristles; the lips are also full of bristles, which serve instead of teeth. In the mouth there are no teeth; only two white flat bones, one in each jaw, with undulated surfaces, which serve in place of grinders. The eyes are extremely small, not larger than those of a sheep; the iris is black: it has no ears, only two very small orifices: the tongue is pointed and small: neck very thick; the head hangs down. The circumference of the body near the shoulders is twelve feet; about the belly twenty; near the tail only four feet eight: the head thirty one inches; the neck seven feet. Near the shoulders are two feet, or rather fins, which are only two feet two inches long, and have neither fingers nor nails; concave beneath, and covered with hard bristles. The tail is thick, strong, and horizontal, ending in a stiff black fin, like the substance of a whalebone.

The skin is very thick, black, and full of inequalities, like the bark of oak. It has no hair on it; but is so hard as scarcely to be cut with an axe. Beneath the skin there is a thick blubber which tastes like oil of almonds. The flesh is coarser than beef, and will not soon putrify. The young ones taste like veal. The skin is used for shoes, and for covering the sides of boats.

The round-tailed manate has thick lips; eyes as minute as a pea; and two very small orifices for ears. Its neck is short, and thicker than its head: it is thickest at the shoulders, and tapers gradually to the tail, which is quite round, lies horizontally, is thickest in the middle, growing thinner to the edges. The feet are placed at the shoulders; beneath the skin there are bones for five complete toes; near the base of each foot, in the female, is a small teat. The skin is very thick and hard, having some few hairs scattered over it. Dampier measured some of these animals in the West Indies ten or twelve feet long; their tails twenty inches long, and fourteen broad. Some of the largest weighed twelve hundred pounds. Clusius examined one sixteen feet and a half long, and Gomora speaks of them of the length of twenty feet.

The manates which entirely inhabit fresh waters, according to

Dampier, are much less than the other. Those of the higher parts of the Oronoque weigh only from five hundred to seven hundred and fifty pounds. They inhabit the rivers of Africa, from Senegal to the Cape; and those of South America also. They sometimes live in the sea, near the mouth of some great river; into which they come once or twice in twenty four hours, for the sake of browzing on the marine plants which grow within their reach. They delight in brackish, or sweet water, rather than in salt, and in shallow water near low land, and in places secure from surges and rapid tides. It is said that at times they frolic and leap to great heights out of the water. They are taken with a harpoon stuck in the end of a staff, which the Indians use with great dexterity. The Spaniards call them fish-cows.

The extraordinary history of a tame manate, preserved by a prince of Hispaniola, in a lake adjoining his residence, at the time of the arrival of the Spaniards, deserves to be mentioned. It was, on account of its general nature, called in the language of the country, matum. It would appear as soon as it was called by any of its familiars; for it hated the Spaniards, on account of an injury it had received from one of those adventurers. The fable of Arion was here realised. It would offer itself to the Indian favourites, and carry over the lake ten at a time, singing and playing upon its back. Matum at last, however, escaped to its native waters by means of a violent flood.

These animals are easily tamed, grow very fond of music, and are the dolphin tribe of the ancients.

The sea-ape is five feet long, with a head like a dog's; erect and sharp ears; large eyes; a sort of beard on both lips; body round, thickest near the head, tapering to the tail, which is bifurcated; the upper lobe the longest; body covered with thick hair, grey on the back and red on the belly. Mr. Steller, who first noticed it, could discover neither feet nor paws. It is full of frolic, plays a thousand monkey tricks; sometimes swimming on the side, sometimes on the other side of a ship, looking at it seemingly with great amazement. It will come so near the ship that it may be touched with a pole; but if any body stir, it immediately retires. It often rises one third of its body above the water, and stands erect for a considerable time: then suddenly darts under the ship, and appears in the same attitude on the other side; and repeats this for thirty times together. It frequently brings up a sea plant, not unlike the bottlegourd, which it tosses about and catches in its mouth, playing a thousand humour-

ous antics. These seem, also, to be alluded to by the ancients under the name of dolphins.

[*Shaw.*

SECTION V.

Mammoth.

Manis megatherium.—Cuvier.

This prodigious animal has a near resemblance to the elephant, but having never been found alive, nor even with its organs in a perfect state after death, we are not able to give its generic characters very accurately. From some late accounts received from St. Petersburgh, it is supposed by some that the animal is still in existence, its carcase having been found nearly fresh, though it has never been seen actually alive. Its residence appears to have been confined to a line in the northern hemisphere, extending from Siberia to the banks of the Ohio; and the name of the mammoth was first given to the dug-up skeleton of the animal by Siberian peasants.

The following account, received from St. Petersburgh, is the fullest and most accurate that has hitherto been published; and relates to a specimen found, not indeed alive, but complete, in a state of nearly perfect preservation.

Schoumachoff, a Tungoose chief, about the end of August, 1799, when the fishing in the river Lena was over, repaired according to annual custom to the sea-side. Leaving his family in their huts, he coasted along the shore in quest of mammoth's tusks, and one day perceived in the midst of a rock of ice a large shapeless block, not at all resembling the logs of drift wood commonly found there. He climbed the rock, and examined it all round, but could not ascertain what it was. The next year visiting the same spot, he found the carcase of a sea-cow *(trichecus rosmarus)*; and observed, not only that the mass he had seen the year before was freer from ice, but that there were two similar pieces by the side of it. These afterwards turned out to be the feet of the mammoth. In 1801, the side of the animal and one of its tusks appearing very distinctly, he acquainted his wife and some of his friends with what he had found. This, however, gave them great alarm, for the old men said, that they had been told by their fore-

fathers, a similar monster was once before seen in those parts, and the whole family of the person who discovered it soon became extinct. At this Schoumachoff was so much alarmed that he fell sick. On his recovery, however, he could not relinquish the expectation of the profit he might make of the tusks; and directed his servants to conceal the circumstance carefully, and endeavour to keep away all strangers by some pretext or other. It was not till the fifth year, that the ice had melted sufficiently to disengage the mammoth, when it fell over on its side upon a bank of sand. Schoumachoff then cut off the tusks, which he bartered for goods to the value of 50 rubles (£. 11 5*s*.) with a Russian merchant. Being satisfied with this, the carcase was left to be devoured by the bears, wolves, and foxes, except what the Yakouts in the neighbourhood cut off to feed their dogs. Previous to this, indeed, he had a rude drawing made of it, which represents it with pointed ears, very small eyes, horse's hoofs, and a bristly mane extending along the whole of its back. In this it has the appearance of something between a pig and an elephant.

In 1806, Mr. Mich. Adams, of Petersburg, being at Yakoutsk, fortunately heard of this circumstance, and repaired to the spot. When he arrived there, the skeleton, nearly stripped of its flesh, was entire, one of the fore-feet excepted. The vertebræ, from the head to the os coccygis, one of the shoulderblades, the pelvis, and the remaining three extremities, were still held firmly together by the ligaments of the joints, and by strips of skin and flesh. The head was covered with a dry skin. One of the ears, well preserved, was furnished with a tuft of bristles. These parts could not avoid receiving some injury during their removal to Petersburg, a distance of 11000 wersts [6875 miles]: the eyes however are preserved, and the pupil of the left eye is still distinguishable. The tip of the under lip was eaten away; and the upper being destroyed, the teeth were exposed. The brain, which was still within the cranium, appeared dry. The parts least damaged were one of the fore-feet and one of the hind: these were still covered with skin, and had the sole attached to them.

According to the Tungoose chief, the animal was so corpulent and well fed, that its belly hung down below the knee joints. It was a male, with a long mane, but had neither tail nor trunk. From the structure of the os coccygis however, Mr. Adams is persuaded, that it had a short thick tail: and from the smallness

of its snout, and the size of its tusks, he conceives it could not have been able to feed without the assistance of a proboscis; but Schoumachoff persisted in the assertion, that he never saw any appearance of a trunk, and it does not appear probable, that even his rude draftsman would have omitted such a striking feature. The skin, three-fourths of which are in possession of Mr. Adams, the part that lay on the ground having been preserved, was of a deep grey colour, and covered with reddish hair and black bristles. These, from the dampness of the ground, had lost some part of their elasticity. More than a poud [40lbs.] weight of them, that had been trodden into the ground by the bears, was collected, many of them an archine [2 feet 4 in.] long. What remained of the skin was so heavy, that ten persons found great difficulty in carrying it to the sea-side, in order to stretch it on logs of wood. The head weighs 11½ pouds [460 lbs.]; the two horns, each of which is 1½ toise [9½ feet] long, weigh 10 pouds [400 lbs.]; and the entire animal measured 4½ archines [10⅓ feet] high, by 7 [16½ feet] long. Mr. Adams has seen tusks of the mammoth so curved as to form three-fourths of a circle; and one at Yakoutsk 2½ toises [15 feet 9 in.] long, an archine [2 feet 4 in.] thick near the root, and weighing 7 pouds [280 lbs.]. They are curved in the direction opposite to those of the elephant, bending towards the body of the animal; and the point is always more or less worn on the outer-side, so that the right tusk is easily distinguishable from the left. He adds, that he found a great quantity of amber on the shores.

In America this animal, or one so nearly resembling it, as probably to be only a distinct species of the same genus, has only been found in a fossil state; and generally only particular parts or bones of the animal have been discovered in one place, though other parts have often been traced at no great distance. This has frequently occurred near the lakes of Canada, where the animal is called by the savages, the father of oxen; near the rivers which fall into the Ohio; towards the rivers Miami, Muskingum, in the state of Kentucky, and of Tennessee, &c. &c. but principally near the salt springs, where pieces of skeletons and tusks have been found, of an astonishing length and weight.

A femur and a tibia have been found, which, when united, must have been five feet and a half high; another femur, which was alone five feet long, and 36 inches in circumference in its middle or cylindrical part; ivory tusks resembling those of an elephant,

which were near seven feet long, and one foot six or eight inches in circumference at the base. Dr. Barton and Dr. Wislar, of Philadelphia, have in their possession the lower jaw almost entire, with two teeth on either side, in particular, that of the former has five and three points, all quite double; but no one had the entire head.

The state of New York (in the environs of the beautiful river Hudson) has of late years been the theatre of discoveries of the fossil bones, apparently of the same animal, a greater quantity of them having been found there than any where else. In 1800, by digging in the low and marshy places of the counties of Orange and Ulster, at three, four, and five feet deep, parts, which had never before been discovered, were found. Some bones, ten feet deep in the earth, were as sound and entire as those which had been met with nearer the surface. Some, however, were found broken, particularly those of the head.

In another place, eight miles from the city of New York, an upper jaw bone was found perforated to receive a tusk like that of an elephant; the connection of the tusks was by *gomphosis;* the tusks were evidently of ivory; the openings for the nostrils were eight inches in diameter; and notwithstanding that the bones of the feet afford reason to conclude that the animal had claws, it is scarcely possible to avoid thinking, from the structure of the head, that it was a species of elephant. Some hair has even been found, three inches in length and of a dark colour, which is said to have belonged to this monstrous quadruped, and seems very considerably to assimilate it to the mammoth of Siberia; though M. Cuvier inclines to believe that the two animals constituted different genera, the tusks of the Siberian animal exhibiting more of a genuine elephant or ivory structure, and less sharpness in its grinders.

In the year 1801, Mr. William Peale, proprietor of the museum at Philadelphia, succeeded in obtaining a skeleton so nearly complete, as by the addition of one or two defective bones, obtained from the fossile remains of other animals of the same kind, to render it perfect. This skeleton was brought over to England by the son of the discoverer, and publicly exhibited in 1803; the writer of the present article examined it minutely, and from actual measurement, and the information of the proprietor, is able to give the following detail. The skeleton was dug up in a morass in

the county of Orange, state of New York, about sixty miles N.N.W. from the city of this name, where it was accidentally discovered by farmers who were digging shell marle for manure. The skeleton measured eleven feet high, seventeen and a half long, and five feet eight inches wide: the under jaw alone weighed sixty-three pounds, and the whole skeleton about 1000 pounds. The tusks were different in form and substance from those of the elephant; the spinous processes over the shoulders were prodigiously large and ridgy, so that the back must have been sharp like that of the hog; the ribs were short, narrow, and placed edgewise, and altogether unlike those of the elephant, which are broad and flat; the tail, unlike that of the Siberian mammoth, appeared to have been long, broad, and flat; the scapulæ were unlike those of other animals. The Philosophical Society of Philadelphia is in possession of a skeleton in some degree more perfect.

The generic name of megatherium was first bestowed upon this animal by M. Cuvier, who appears accurately to have examined its skeleton: and to this generic name he added the trivial name of Americanum, to distinguish the individual from which his observations was made. In Dr. Shaw it occurs under the name of manis megatherium.

The following is M. Cuvier's description.

"This skeleton is fossil. It was found a hundred feet beneath the surface of a sandy soil, in the vicinity of the river of La Plata. It only wants the tail, and some pair-bones, which have been imitated in wood; and the skeleton is now mounted at Madrid. This skeleton is twelve feet (French) long, by six feet in height. The spine is composed of seven cervical, sixteen dorsal, and four lumber vertebræ: it has consequently sixteen ribs. The sacrum is short: the ossa illia is very broad; and their plane being almost perpendicular to the spine, they form a very open pelvis. There is no pubis or ischium: at least they are wanting in this skeleton, and there is no mark of their having existed when the animal was alive.

"The thigh bones are excessively thick, and the leg bones still more so in proportion. The entire sole of the foot bore on the ground in walking. The shoulder-blade is much broader than long. The clavicles are perfect, and the bones of the fore-arm are distinct and moveable upon each other. The fore limbs are longer than the hind. To judge by the form of the last phalanxes,

there must have been very long pointed claws, enclosed at their origin in a long sheath. There appears to have been only three of these claws on the fore-feet, and a single one on the hind. The other toes seem to have been deprived of them, and perhaps entirely concealed beneath the skin.

"The head is the greatest singularity of this skeleton. The occiput is elongated and flattened, but it is pretty convex above the eyes. The two jaws form a considerable projection, but without the teeth, all grinders, with a flat crown and grooved across. The breadth of the branches of the lower jaw, and the great apophysis placed on the base of the zygomatic arch, deserve particular notice.

"This quadruped in its character, taken together, differs from all known animals: and each of its bones considered apart, also differs from the corresponding bones of all known animals. This results from a detailed comparison of the skeleton with that of other animals, and will readily appear to those who are conversant in such researches: for none of the animals which approach it in bulk have either pointed claws, or similarly formed head, shoulder-blades, clavicle, pelvis, or limbs.

"As to its place in the system of quadrupeds, it is perfectly marked by the sole inspection of the ordinary indicatory characters, that is, the claws and teeth. These shew that it must be classed in the family of unguiculated quadrupeds, destitute of cutting teeth; and in fact it has striking relations with those animals in all parts of its body. This family is composed of the sloth (bradypus), armadillo (dasypus), pangolin (manis), ant-eater (myrmecophagus), and Cape ant-eater (orycteropus).

"The great thickness of the branches of the lower jaw, surpassing even that of the elephant, seems to prove that this vast animal was not content with leaves, but like the elephant and rhinoceros, broke and ground the branches themselves; its close and flat-crowned teeth appearing very proper for that purpose. The position of the bones of the nose having some analogy with that of the elephant and tapir, would induce an opinion that our animal wore a trunk, but it must have been very short, since the length of the head and neck together only equals that of the fore legs. However this be, we find, in the absence of canine teeth, and the shortness of the muzzle, sufficient characters to constitute a new genus in the family of the edentated, which ought to be placed between the sloth and

the armadillo; since to the shape of the head of the former it joins the teeth of the latter. It would be necessary to know particulars of which a skeleton cannot inform us, such as the nature of the teguments, the form of the tongue, the position of the mammæ, &c. in order to determine to which of these it approached the most.

"This adds to the numerous facts which apprise us that the animals of the ancient world were all different from those we now see on the earth; for it is scarcely probable that if this animal still existed, so remarkable a species would have hitherto escaped the researches of the naturalists. It is also a new and very strong proof of the invincible laws of the *subordination* of characters, and the justness of the consequences thereon deduced for the classification of organized bodies: and under both these views it is one of the most valuable discoveries which have for a long time been made in natural history." [*Pantologia.*

SECTION VI.

Duck-Bill.

Platypus anatinus.—SHAW.

THIS singular quadruped forms one of the wonders of Australasia: and we shall take our account of him from Dr. Shaw's spirited and accurate description.

Of all the mammalia, says he, yet known, it seems the most extraordinary in its conformation; exhibiting the perfect resemblance of the beak of a duck, engrafted on the head of a quadruped. So accurate is the similitude, that at first view it naturally excites the idea of some deceptive preparation by artificial means: the very epidermis, proportion, serratures, manner of opening, and other particulars of the beak of a shoveller, or other broad-billed species of duck, presenting themselves to the view: nor is it without the most minute and rigid examination that we can persuade ourselves of its being the real beak or snout of a quadruped.

The body is depressed, and has some resemblance to that of an otter in miniature: it is covered with a very thick, soft, and beaver-like fur, and is of a moderately dark brown above, and of a subferruginous white beneath. The head is flattish, and rather small than large; the mouth, or snout, as before observed, so exactly resembles that of some broad-billed species of duck, that

it might be mistaken for such; round the base is a flat circular membrane, somewhat deeper or wider below than above; viz. below near the fifth of an inch, and above about an eighth. The tail is flat, furry like the body, rather short and obtuse, with an almost bifid termination; it is broader at the base, and gradually lessens to the tip, and is about three inches in length: its colour is similar to that of the body. The length of the whole animal, from the tip of the beak to that of the tail, is thirteen inches; of the beak an inch and half. The legs are very short, terminating in a broad web, which on the fore-feet extends to a considerable distance beyond the claws; but on the hind-feet reaches no farther than the roots of the claws. On the fore-feet are five claws, strait, strong, and sharp-pointed; the two exterior ones somewhat shorter than the three middle ones. On the hind-feet are six claws, longer and more inclined to a curved form, than those of the fore-feet; the exterior toe and claw are considerably shorter than the four middle ones; the interior or sixth is seated much higher up than the rest, and resembles a strong sharp spur. All the legs are hairy above; the fore feet are naked both above and below; but the hind-feet are naked above and hairy below. The internal edges of the under mandible (which is narrower than the upper), are serrated or channelled with numerous striæ, as in a duck's bill. The nostrils are small and round, and are situated about a quarter of an inch from the tip of the bill, and are about the eighth of an inch distant from each other. There is no appearance of teeth; the palate is removed, but seems to have resembled that of a duck; the tongue also is wanting in the specimen. The ears or auditory foramina are placed are placed about half an inch beyond the eyes; they appear like a pair of oval holes, of the eighth of an inch in diameter, there being no external ear. On the upper part of the head, on each side, a little beyond the beak, are situated two smallish oval white spots, in the lower part of each of which are imbedded the eyes, or at least the parts allotted to the animal for some kind of vision; for, from the thickness of the fur and the smallness of the organs, they seem to have been but obscurely calculated for distinct vision, and are probably like those of moles, and some other animals of that tribe; or perhaps even subcutaneous; the whole apparent diameter of the cavity in which they were placed not exceeding the tenth of an inch.

"When we consider the general form of this animal, and parti-

cularly its bill and webbed feet, we shall readily perceive that it must be a resident in watery situations; that it has the habits of digging or burrowing in the banks of rivers, or under ground; and that its food consists of aquatic plants and animals. This is all that can at present be reasonably guessed at; future observations, made in its native regions, will, it is hoped, afford us more ample information, and will make us fully acquainted with the natural history of an animal which differs so widely from all other quadrupeds, and which verifies, in a most striking manner, the observation of Buffon; viz. that whatever was possible for nature to produce, has actually been produced.

On a subject so extraordinary as the present, a degree of scepticism is not only pardonable, but laudable; and I ought, perhaps, to acknowledge that I almost doubt the testimony of my own eyes with respect to the structure of this animal's beak; yet must confess, that I can perceive no appearance of any deceptive preparation; and the edges of the rictus, the insertion, &c. when tried by the test of maceration in water, so as to render every part completely moveable, seem perfectly natural; nor can the most accurate examination of expert anatomists discover any deception in this particular.

[*Shaw.*

SECTION VII.

Sheep.

Ovis aries.—Linn.

This valuable animal inhabits the whole globe; changes its teeth with its age; feeds on short tender grass, chiefly sheep's fescue; has a peculiar tone, which is called bleating. The ram is esteemed the best-shaped that has a thick head, a broad front, large black eyes, a broad nose, a long, high body, a large crupper and large reins, massy testicles, and a long tail. His colour should be white; his fleece full and heavy. Those ewes are preferred which have thick necks, large, soft, and silky fleeces, large bodies, and a nimble motion in walking. One ram suffices for fifty ewes.

Sheep are not among the most sagacious of the lower animals. They neither display the same natural dexterity and address, nor the same docility as the dog, the horse, and some other of the tame

animals, whose mental powers are considered as the most remarkable. Yet they are not absolutely stupid, as they have sometimes been represented. They are social; the flock follow a ram as their leader; the leader often displays the most impetuous courage in defence of his followers. Dogs, and even men, when attempting to molest a flock of sheep, have often suffered from the generous valour of the rams. The mutual affection, at least, between the female parent and her progeny, is here sufficiently tender, and well adapted to its purposes. The ewe suckles her lamb with fondness; and though her timidity, weakness, and want of formidable instruments of attack and defence, render her unable to make any powerful opposition to those who seek to deprive her of it; yet she bleats after it, and for some time laments its loss with the tenderest complaints. A lamb separated when young from other sheep, fed with milk from the hand, and treated with tenderness and familiarity, displays considerable docility, and often forms a strong attachment to its benefactors. Admitted to this intimacy with mankind, it is apt to be guilty of little vicious tricks; but its mildness and general inoffensiveness of manners, recommend it so strongly to human affection and regard, that it is usually a particular favorite of infancy and youth. It often eludes the vigilance of the shepherd, when it wishes to steal some delicacy of food agreeable to its palate.

The ram becomes able to propagate his kind at the age of eighteen months: the ewe is ready to receive the male when a year old. The period at which the ewes are in season for the ram, is between the beginning of September and the end of November; but if fed in good pastures, or nourished on purpose with stimulating food, they will conceive at any time in the year. It is best to permit them to mix with the rams at such a time, that they may bring forth when there is the greatest abundance of grass for feeding the lambs produced. In this country, the first lambs usually appear in the beginning of February; and their number continues to increase, at least till May. The rams and the ewes are to be kept separate, when it is wished that they should not copulate.

The ewe usually produces only one lamb at a time. There are generally, however, a good many instances of two in a flock; and on some very singular occasions, one parent will produce three lambs at a birth. It is observable of this species, that they drink very little. The juice of the vegetables which they eat, and the

dew and rain with which the grass is often moistened, supply almost all the moisture that they need.

Sheep, like other animals, are liable to various diseases. Water often collects in the head, and produces a disorder which soon proves fatal : the feet of whole flocks are often affected with a sort of mortification, which makes them halt when they walk, and renders them almost unable to run ; they are subject to the scab, and an eruptive disorder like the small-pox..

The dropsy, consumption, jaundice, and worms in the liver, are also annually destructive to considerable numbers of sheep. Several sorts of insects infest this animal. A particular species of œstrus, or gadfly, is very troublesome, by depositing its eggs above the nose, in the frontal sinuses; a tick and a louse likewise feed on the sheep; of which it is sometimes relieved by the undistinguishing appetite of the magpie and the starling. The ordinary term of the life of those sheep which escape disease and violence, is twelve or thirteen years.

The benefits which mankind owe to this animal are very numerous. Its horns, its fleece, its flesh, its tallow, even its bowels are all articles of great utility to human life.

The horns are manufactured into spoons, and many other useful articles.

The manufacture of the wool into cloths has long formed the principal source of the riches of England. We know not indeed whether the simple Britons, and the rude Saxons, were acquainted with the important uses of wool; it is more probable that they were not. But Henry the Second paid so much attention to the manufacture and improvement of this commodity, as to forbid the use of any other than English wool in the making of cloth. Yet, the excellence of English wool was long known, before the English paid much attention to the art of making woollen cloth, or attained any superior skill in it. Wool was then a staple article for exportation ; and the Flemings were our merchants. But in the reign of Elizabeth, severable favourable circumstances, which the talents and the patriotic spirit of that princess enabled her to take advantage of, concurred to establish the woollen manufactory in England, and to lay the foundation for that perfection it has since attained. In Scotland this manufacture has never thriven greatly. Yet, the bonnets, which, though now very much out of use, were in former times very generally used as a covering for the head, and

the stockings of such superior fineness, for which the Isles of Shetland, and the city of Aberdeen are still celebrated, are articles which shew that the inhabitants of Scotland have not been much less capable of ingenuity in this way, than their neighbours of England. The Spanish wool has been much celebrated; and it is not very long since, broad cloth bearing the name of Spanish, was prized above the English. But the wool produced in Britain has been, by various arts, so much improved, as to be now, not inferior in excellence to that of Spain; and no woollen cloth is at present esteemed superior to that of English manufacture. The sheep with the finest fleeces in England, are fed on the Coteswold Downs, and in Herefordshire, Devonshire, Lincolnshire, Suffolk, and Yorkshire. The wool of Wales is coarse; nor is that of Scotland, except in some instances, remarkable for fineness. The wool of the small sheep in the Highlands, and the Isles of Scotland, is superior to the finest Spanish or English wool.

The skin of this animal is prepared into leather, for an inferior sort of shoes, for the coverings of books, for gloves, and for parchment.

The entrails, by a proper preparation, are made into strings for various musical instruments.

The milk of the sheep is thicker than cow's milk. Its taste is somewhat disagreeably strong. It is hence rather made into cheese than used for drinking. The cheese is rich, and of a high flavour. It would probably be still better, if more attention were paid to cleanliness in the preparation. It were perhaps best to leave all the milk of the ewe to her lamb.

The flesh of the sheep is one of our most valuable articles of animal food. It is neither disagreeably coarse, nor yet so tender and delicate as not to afford strengthening nourishment. The flesh of the lamb is, in the proper season, one of the nicest delicacies that the epicure can desire.

The bones are useful for various purposes. Of these, as well as of other bones calcined, are made the cupels used in the refining of metals.

Mr. Pennant mentions the dung as an excellent manure. But it is not often that sheep are fed in such numbers on arable land, as that their dung can be collected for this purpose.

The modes of managing sheep differ in different countries, and even in the same country. The lambs are seldom separated from

their mothers till they become large and vigorous. As one ram is able to impregnate a good many ewes, only a small proportion of the male lambs are permitted to retain their organs of generation unmutilated. Wedders are less vicious than rams; and their flesh has a better flavour and relish. In summer, before being shorn, sheep are commonly washed, to improve the whiteness of the wool. Where sheep are not shorn, they change their fleeces annually; and the best time for shearing is, when the fleece is just ready to fall off of itself. The time of the sheep-shearing is always a period of festivity with the shepherds. It was such in ancient times among the shepherds of Judæa, 2 Sam. xiii. 23. In Scotland, and in other northern countries, sheep are usually smeared with a mixture of butter and tar about the end of autumn, to fortify and protect them against the severities of winter. It seems a necessary precaution, where the flocks cannot be sheltered in sheds, and fed with hay and other suitable food, during the inclemency of the severe season. But this mixture of tar and butter is often so injudiciously laid on, as to injure the health of the sheep, and even to render its fleece less warm than it would otherwise be. It greatly contaminates the whiteness of the wool; but if the butter be in due proportion, is, perhaps, rather favourable to its fineness. In the sheep countries of Scotland, it is often necessary to remove the flocks in winter from the hills on which they usually feed, to low lands, where they may find some herbage, and be protected from the severity of the season. Could the practice of folding sheep in sheds, and feeding them with hay, or leaves of cabbage, common green kail, or turnips, during the storms of winter, be conveniently adopted through Scotland, it would possibly prove highly advantageous to their proprietors. Even in the mildest winters, considerable numbers perish under the present modes of management. Crawford muir, in Clydesdale, is one of the chief sheep countries in Scotland. The management of sheep there is well understood. The natives of Clydesdale have, of late, attempted to teach the inhabitants of the Highlands how to manage their sheep better, and to derive greater profits from them.

Even in Britain we have a good many different breeds of this animal. Linnæus distinguishes the breed peculiar to England, as destitute of horns, and having its tail and scrotum depending to the knees. This is the fine, large breed for which Warwickshire and particularly Lincolnshire, is noted. They have, in the course of

the last twenty years, been introduced into Galloway, and other parts of Scotland, under the denomination of mugg sheep. Their flesh is rather coarse, and their wool intermixed with dry hair. It is the hornless sheep of Pennant.

Our other sheep are chiefly of the common horned breed. In Wales, and through most of the sheep pastures in Scotland, they are small and hardy. In delicacy of flavour and relish, their flesh is much superior to that of the larger breed; and even their wool, where the nature of their pasture is not such as to injure it greatly, is said to be of the best quality. The common colour is white; yet we sometimes observe a black, or a dark grey fleece, and a smutted face: this is called the common sheep, as being more common than any other variety of the species, throughout all Europe. Some ancient writers speak of a breed of sheep with golden teeth, as belonging to Scotland. This appears, at first sight, incredible; but Mr Pennant has explained the wonder, by telling us, that he saw at Athol house, in the year 1772, the jaws of an ox, containing teeth thickly incrusted with a gold-coloured pyrites. The same thing might happen to sheep.

The northern regions of Europe, particularly Gothland and Iceland, afford another variety of the sheep, distinguished by having their heads furnished with three, four, or even five horns. Besides this abundance of horns, the sheep of Iceland are remarkable for straight, upright ears, and very small tails. In stormy weather, the sheep of Iceland, by a peculiar instinct, retreat for shelter to the caves and caverns, which are very numerous over the face of that island; but when the storm of snow comes on too suddenly to afford them time to gain such a retreat, the flock gather into a heap, with their heads towards the middle, and inclined to the ground; a posture in which they will remain several days, without perishing under the snow. Among the herbs on which they feed, the inhabitants of Iceland remark that scurvy-grass contributes most to fatten them. When the summer crop happens to fail, the Icelanders are obliged to feed their sheep in winter with chopped fish bones. Those sheep appear to afford milk in more abundance than ours. Dr. Van Troil says, they give from two to six quarts a-day. The fleece is not shorn from the sheep in that island as with us: about the end of May, it loosens of itself, and is stripped off at once, like a skin.

The Spanish sheep, remarkable for the fineness of their wool,

and distinguished by spiral horns, bending outwards, are of a breed believed by some writers, to have been originally introduced into that kingdom from England. Mention is made, indeed, of two varieties of Spanish sheep; one of which is highly valued for the fineness and quantity of the wool, while the fleece of the other is of a very inferior quality. The greater part of the flocks in Spain are of the former variety; and the care with which they are managed, renders the business of the shepherd much more complex in Spain, than in most other countries. The number of sheep fed in Spain is above four millions. In summer, the flocks feed on the mountains in the northern parts of the kingdom; in winter, they are conducted into the milder plains of Estremadura, and Andalusia, and distributed into districts. A flock consists usually of about ten thousand sheep, under the management of a head shepherd, with fifty inferior shepherds, and as many dogs. In summer, the sheep are made to eat a great quantity of salt. The rams are, as is usual in other places, kept in separate flocks, except during the rutting time. This begins about the end of July; and they are then distributed about the ewes. The fleece of a ram frequently weighs about five-and-twenty pounds; that of a ewe scarce ever more than five: but the wool of the ram is not equally fine with that of the ewe. In the middle of September, the shepherds mark the sheep of their flocks on the loins, with ochre, diluted in water. This smearing with ochre not only distinguishes the sheep of different proprietors, but is also supposed to render the wool closer and warmer, and to contribute to the preservation of the sheep's health. The end of September is the period, about which the flocks are conducted from the mountainous pastures, where they have spent the summer, to milder and lower regions. The shepherds are careful to conduct each flock, if possible, to the same pastures where it has fed in former winters. The lambs are produced early in the season, in consequence of the rams having been admitted to the ewes about the end of July. In March, the lambs are trimmed of a part of their tails, and the tips of their horns, and marked on the nose with a hot iron; and such of the males as are not meant to be kept for rams, castrated, or at least incapacitated for generation, by squeezing of the scrotum, till the spermatic vessels are twisted like a rope. In April, the flocks are led back to their summer pastures. In May, the fleeces are shorn: every fleece contains three sorts of wool; the finest on the back and the belly; a second sort on the neck and the sides; and on the breasts,

the shoulders, and the thighs, a coarser species. Considerably more than 9,700,000 lb. weight of wool are annually exported from Spain during peace; of which, notwithstanding the abundance, and the superior quality of our British wool, more than one-third has usually come to England.

The African and Guinea sheep form remarkable varieties of this species. Guinea and the desert of Sahara are the places of which they are originally natives, and whence they have been introduced into America. Their form is meagre; their legs long; ears pendent, and covered, not with wool, but with hair; their neck is shaggy; and the covering of the whole body has so much of the dryness and hardness of hair, that it cannot be with any propriety denominated wool. These are conjectured to be the animals named by Leo Africanus Adimain, and described by him as being of the size of an ass, and of the shape of a ram, with pendent ears.

The Cretan sheep, mentioned by Buffon under the denomination of Wallachian, is remarkable for large spiral horns. The distance between the horns of the ewe enlarges towards their tops; those of the ram are parallel. They are understood to be natives of Candia; numerous flocks of them graze on Mount Ida: they are also spread through the other islands of the Archipelago, and are frequent in Austria and Hungary. The butchers in these last-mentioned countries prefer them to all other sheep. In size, and in the nature of the fleece, they differ not remarkably from the common kind.

Those countries of Asia which abound most in sheep, afford yet another variety, distinguished by the amazing breadth and bulk of their tails.

They do not, as far as we know, differ considerably from our common sheep, in any other respects. They are generally white; yet sometimes vary in colour. The tail is seldom pointed, but commonly either square or round, much like a cushion. The great size of the tail renders it often so incommodious to the sheep, that it is found necessary to support it with a small wheeled machine. Some of these tails weigh more than 50lb.; the common weight exceeds 30lb. Persia, Syria, Arabia, Egypt, Ethiopia, Barbary, and Tartary, all afford this variety.

Of these sheep with large tails, the tails are not all of the same form: some are short and thick; others broad, and of a moderate length; others so remarkably long, as to obtain to the sheep that carry them the denomination of long-tailed sheep. The short,

thick-tailed sheep are common among the Tartars. Thibet affords the broad-tailed sheep, which are in that kingdom distinguished, likewise, for the superior fineness of their wool. This wool, not inferior in quality to that of Caramania, is, like it, wrought into shawls for the great omrahs, which are sold at a higher price than those of any other manufacture. The long-tailed sheep form the flocks of the Dutch colonists, at the Cape of Good Hope. Mr. Patterson, who advanced from the Cape a considerable way into the inland country, relates, that he saw among the Hottentots, in the country adjacent to Orange River, a sort of sheep with much longer tails than those of the sheep about the Cape, and covered, not with wool, but with coarse hair, which gave them, at a distance, the appearance rather of dogs than of sheep. The Cape sheep are not less distinguished by their ears, which are large and pendent, than by their tails. The tail, in its nature between fat and marrow, is a delicacy worthy of the nicest epicure. This variety of the sheep was not unknown to the ancient Greeks and Romans. Aristotle mentions them as inhabitants of Syria; and Pliny, probably on Aristotle's authority, repeats the same fact.

Another variety of this species is the fat-rumped sheep, which is not provided with a tail. Its buttocks swell out like two globes, are perfectly smooth, and scarce leave the os coccygis discernible. Its nose is arched; its ears pendulous; legs slender; head black; fleece commonly white, but at times black, reddish, or spotted. The globular buttocks are composed solely of suet, and are sometimes so large as to weigh forty pounds. The whole body of the sheep frequently weighs two hundred pounds. The voice of this animal resembles rather the lowing of a calf, than the bleating of a sheep.

Sheep of this character abound through the deserts of Tartary, from the Volga to the Irtish and the Altaic chain. They are remarkably prolific; producing usually two, and, not unfrequently, three lambs at a birth.

The sheep of Bucharia are described by Linnæus and Pallas as a particular variety; distinguished by large pendent ears, and a large tail, formed like a cushion. These are represented as a hybrid breed, produced by the copulation of individuals of the long-tailed variety with others, either with broad tails, or of the variety distinguished by the want of a tail. Lambs' skins, possibly of this variety, are brought from Bucharia, Chiva, and the adjacent countries, to Astracan, and there sold at a very high price, on

account of their glossy appearance and furry texture. The wool of some of them is curled; that of others waved. They are used in Persia, Russia, and other parts, for the lining of coats, and the turning-up of caps. These are chiefly the skins of lambs taken out of the bellies of ewes killed during the period of gestation. The instant the lamb is taken out of its mother's belly, it is killed and flayed. Lambs are also killed for their skins, in the same manner, immediately after being brought forth in the natural way; and these are scarce inferior to the others. One of these skins will sell at Astracan for five or six shillings sterling. They are usually grey or black.

[*Pantologia.*

SECTION VIII.

Ox; with a Description of the Spanish Bull-fight.

Bos taurus.—Linn.

The genus bos contains nine species; of which the taurus, or ox is the chief, and is found in all parts of the globe, but in its greatest perfection in our own country. The climate of Great Britain is, above all others, productive of the greatest variety and abundance of wholesome vegetables, which, to crown our happiness, are almost equally diffused through all its parts. This general fertility is owing to those clouded skies, which foreigners mistakenly urge as a reproach on our country; but let us cheerfully endure a temporary gloom, which clothes not only our meadows, but our hills, with the richest verdure. To this we owe the number, variety, and excellence of our cattle, the richness of our dairies, and innumerable other advantages. Cæsar (the earliest writer who describes the island of Great Britain) speaks of the number of our cattle, and adds, that we neglected tillage, but lived on milk and flesh. Strabo takes notice of our plenty of milk, but says we are ignorant of the art of making cheese. Mela informs us, that the wealth of the Britons consisted in cattle; and in his account of Ireland, reports that such was the richness of the pastures in that kingdom, that the cattle would even burst if they were suffered to feed on them long at a time.

This preference of pasturage to tillage, was delivered down from our British ancestors to much later times; and continued equally prevalent during the whole period of our feodal government: the chieftain, whose power and safety depended upon the promptness

Engraved by Lester, from a Drawing by Clennell.

For the Gallery of Nature & Art.

A SPANISH BULL FIGHT

of his vassals to execute his commands, found it his interest to encourage those employments that favoured that disposition; that vassal, who made it his glory to fly, at the first call, to the standard of his chieftain, was sure to prefer that employ, which might be transacted by his family with equal success during his absence. Tillage would require an attendance incompatible with the services he owed the baron, while the former occupation not only gave leisure for those duties, but furnished the hospitable board of his lord with ample provision, of which the vassal was an equal partaker. The relics of the larder of the elder Spencer, are evident proofs of the plenty of cattle in his days; for, after his winter provisions may may have been supposed to have been *mostly* consumed, there were found, so late as the month of May in salt, the carcases of not fewer than 80 beeves, 600 bacons, and 600 muttons. The accounts of the several great feasts in after times, afford amazing instances of the quantity of cattle that were consumed in them. This was owing partly to the continued attachment of the people to grazing; partly to the preference that the English at all times gave to animal food. The quantity of cattle that appears from the latest calculation to have been consumed in our metropolis, is a sufficient argument of the vast plenty of these times; particularly when we consider the great advancement of tillage, and the numberless variety of provisions, unknown to past ages, that are now introduced into these kingdoms from all parts of the world.

Our breed of horned cattle has in general been so much improved by a foreign mixture, that it is difficult to point out the original kind of these islands. Those which may be supposed to have been purely British, are far inferior in size to those on the northern part of the European continent; the cattle of the Highlands of Scotland are exceedingly small, and many of them, males as well as females, are hornless: the Welsh runts are much larger; the black cattle of Cornwall are of the same size with the last. The large species that is now cultivated through most parts of Great Britain, is either entirely of foreign extraction, or our own improved by a cross with the foreign kind. The Lincolnshire kind derive their size from the Holstein breed, and the large hornless cattle that are bred in some parts of England, come originally from Poland.

About two hundred and fifty years ago there was found in Scotland a wild race of cattle, which were of a pure white colour, and had (if we may credit Boethius) manes like lions. I cannot but

give credit to the relation; having seen in the woods of Drumlanrig, in North Britain, and in the park belonging to Chillingham castle, in Northumberland, herds of cattle probably derived from the savage breed. They have lost their manes; but retain their colour and fierceness: they were of a middle size, long legged, and had black muzzles and ears: their horns fine, and with a bold and elegant bend. The keeper of those at Chillingham said that the weight of the ox was 38 stone: of the cow 28: that their hides were more esteemed by the tanners than those of the tame; and they would give six-pence per stone more for them. These cattle were wild as any deer: on being approached would instantly take to flight and gallop away at full speed: never mix with the tame species; nor come near the house, unless constrained by hunger in very severe weather. When it is necessary to kill any, they are always shot; if the keeper only wounds the beast, he must take care to keep behind some tree, or his life would be in danger from the furious attacks of the animal; which will never desist till a period is put to its life.

Frequent mention is made of our savage cattle by historians. One relates that Robert Bruce was (in chasing these animals) preserved from the rage of a wild bull by the intrepidity of one of his courtiers, from which he and his lineage acquired the name of Turn-bull. Fitz-Stephen names these animals (*Uri Sylvestres*) among those that harboured in the great forest that in his time lay adjacent to London. Another enumerates, among the provisions at the great feast of Nevil, archbishop of York, six wild bulls; and Sibbald assures us, that in his days a wild and white species was found in the mountains of Scotland, but agreeing in form with the common sort. I believe these to have been the *Bisontes jubati* of Pliny, found then in Germany, and might have been common to the continent and our islands; the loss of their savage vigour by confinement might occasion some change in the external appearance, as is frequent with wild animals deprived of liberty; and to that we may ascribe their loss of manes. The Urus of the Hercynian forest described by Cæsar, book VI. was of this kind, the same which is called by the modern Germans, *Aurochs*, i. e. *Bos sylvestris*.

The ox is the only horned animal in these islands that will apply his strength to the service of mankind. It is now generally allowed, that in many cases oxen are more profitable in the draught than horses: their food, harness, and shoes being cheaper, and should

they be lamed or grow old, an old working beast will be as good meat, and fatten as well, as a young one.

There is scarce any part of this animal without its use. The blood, fat, marrow, hide, hair, horns, hoofs, milk, cream, butter, cheese, whey, urine, liver, gall, spleen, bones, and dung, have each their particular use in manufactures, commerce, and medicine.

The skin has been of great use in all ages. The antient Britons, before they knew a better method, built their boats with osiers, and covered them with the hides of bulls, which served for short coasting voyages.

> Primum cana salix madefacto *vimine* parvam
> Texitur in Puppim, *cæsoque* induta juvenco,
> Vectoris patiens, *tumidum* super emicat amnem :
> Sic Venetus stagnante Pado, fusoque Britannus
> Navigat oceano. LUCAN. lib. iv. 131.

> The bending willow into barks they twine:
> Then line the works with spoils of slaughter'd kine.
> Such are the floats Venetian fishers know,
> Where in dull marshes stands the settling Po;
> On such to neighbouring Gaul, allured *by gain*,
> The bolder Britons cross the swelling main.
> ROWE.

Vessels of this kind are still in use on the Irish lakes; and on the Dee and Severn: in Ireland they are called *Curach;* in England *Coracles,* from the British *Cwrwgl*, a word signifying a boat of that structure.

Bull Fights in Spain. Among the diversions and pastimes of the Spaniards, there is none so peculiar and interesting as their bull feasts; it will be necessary therefore to insert here the account of the bull feast exhibited in the Plaça Mayor, at Madrid, upon occasion of the late king's public entry into his capital, on the 15th of July, 1760, as given by Mr. Clark, although compelled to take his ideas without adhering to his verbal description.

The square which is large, was thronged with people, and all the balconies ornamented with different-coloured silks, and crowded from the top to the bottom of the houses; the avenues to the square were built up into balconies, and a sloping scaffold placed round for the common people, and raised about eight or nine feet from the ground.

First came the coaches of the cavaliers, who were to encounter the bulls; these coaches were four in number, of a singular make, with glasses at the ends, and quite open at the sides: the cavaliers were placed at the doors of their coaches; and bowed to the people in the balconies as they passed round the square. They were accompanied by their sponsors, the dukes of Ossuna, Banos, Arcos, and Medina Cæli. Before the royal family came a company of halberdiers, followed by seven or eight of the king's coaches, preceding his coach of state, which was extremely rich, with red and gold ornaments, and beautiful painted pannels. Then came a coach with some of the great officers; and next came the king and queen in a very sumptuous coach of blue, with all the ornaments of massive silver, and a crown at the top: the trappings of the horses were likewise silver, with large white plumes. They were followed by the coaches of the prince of Asturias, the two infantas, and don Lewis, with their attendants.

The king and queen seated themselves oppposite to the balcony of the English ambassador, in which our author sat; they were in a gilt balcony, with a canopy and curtains of scarlet and gold. On the right hand of the king's balcony were placed the rest of the royal family; and on the left the gentlemen of the bed-chamber in a row, all dressed in a very fine uniform of blue and red, richly embroidered with gold. The halberdiers marched from the king's balcony, which was in the centre of one side, and forming themselves into two lines fronting different ways, cleared the square of the crowd, who retired into the scaffolds erected for them; after which the halberdiers formed themselves into a line before the scaffold under the king's balcony. Then two companies of boys, dressed in an uniform, with caps and red taffety jackets, came with buckets of water in their hands, and watered the stage as they crossed over it to the opposite side: the six chief alguazils of the city then appeared, mounted on fine horses, covered with trappings; they were dressed in the old Spanish habit, black, with slashed sleeves, great white flowing wigs, and hats with plumes of different coloured feathers: these magistrates advanced towards the king's balcony, under which they remained the whole time to receive his orders, except when they were frightened from their post by the bulls.

The troops belonging to the cavaliers next ascended the stage in four large companies, dressed in silk Moorish liveries, richly and elegantly ornamented with lace and embroidery: these first bowed

to the king's balcony, and then went in procession round the square: the elegant singularity of their uniforms produced a very pleasing effect. After them came the four knights in the old Spanish dress, with plumes in their hats, mounted on fine horses: each held in his hand a slender lance, and was attended by two men on foot dressed in light silk of the colour of his livery, with cloaks of the same; these never forsake his side, and are his principal defence. The cavaliers then disposed themselves for the encounter, the first placing himself opposite to the door of the place where the bulls were kept, and the other at some distance behind him.

At a signal given by the king the doors opened, and the bull appeared, to the sound of martial music, and the loud acclamations of the people, when seeing one of the attendants of the first cavalier spreading his cloak before him, he aimed directly at him; but the man easily avoided him, and gave his master the opportunity of breaking his spear in the bull's neck. In the same manner the bull was tempted to engage the other cavaliers, and always with the same success, till having received the wounds with their lances, he was encountered by the other men on foot; who, after maintaining a sportive conflict with incredible agility as long as they thought proper, easily put an end to him by thrusting a sword either into his neck or side, which brought him to the ground, and then they finished him at once, by striking a dagger, or sword, behind his horns into the spine, which is always immediate death. After this the bull is hurried off by mules, finely adorned with trappings.

After the knights were sufficiently tired with these exploits, the king gave them leave to retire; bulls were then let out, one at a time, from another door; these were of a more furious nature, and were encountered entirely by men on foot, who were so far from fearing their rage, that they strove to increase it, by darting at their necks, and other parts, little barbed darts ornamented with bunches of paper; some of which were filled with gun-powder, and were no sooner fastened to the bull than they went off like serpents. Nothing can be imagined more tormenting than these darts; but the amazing dexterity with which they are thrown, diverts the attention from its cruelty. They also dress up goats' skins, blown up with wind, and increase the fury of the bull by placing them before him, which makes a very ridiculous part of the entertainment. Many of the bulls, however, would not attack them; and one of the most furious that did, shewed

more fear in that onset, than in encountering his most sturdy antagonist. They also baited one bull with dogs, and these animals shewed as much courage as any of the bull-dogs in England.

"My apprehensions," says our author, "were at first principally excited for the men on foot; but the knights are in much more danger, their horses being too full of fire to be exactly governed; they cannot therefore so well avoid the aim, and are liable to be every moment overthrown, with their horses, if their attendants by their side do not assist them. Two beautiful horses were gored; one of which was overthrown with his rider, but fortunately the man received no hurt from his fall. The courage of these horses is so great, that they have been often known to advance towards the bull, when their bowels were trailing on the ground."

The bull-feast in the Plaça Mayor is never exhibited but upon some extraordinary occasion, as the accession or marriage of their kings, and is attended with very great expence, both to the king and the city. But there is a theatre built without the walls, where there are bull-feasts every fortnight, which to connoisseurs are greatly preferred to the others, the bulls being more furious, and the danger greater to those who fight them; but there is little difference in their manner of engaging them.

[*Pennant. Payne.*

SECTION IX.

Horse.

Equus caballus.—LINN.

THIS well known and most useful animal is cultivated with care in most parts of the earth; but is found in its natural state in the deserts of Great Tartary; sometimes in Africa: timid, swift, vigilant; moves in flocks, having a leader before, with his ears thrown forwards, and a centinel behind, with his ears bent back, to guard against surprise both ways. It varies much in size and colour; feeds on grain and herbage; generous, proud, spirited; drives away flies and insects with its tail; carefully guards its hind parts; calls after its companion by neighing; and scratches its shoulder with its teeth; rolls itself when hot; is without gall-bladder, but has large gall ducts to answer the purpose; does not vomit or eructate; its dung heats and smokes; changes its fore-teeth in the second, third,

Engraved by C. Middlemist from a Drawing by L. Clennell. *for the Gallery of Nature & Art.*

A BOAR HUNT.

and fourth years; acquires tusks in the fifth; gravid two hundred and ninety days.

The breed of horses in Great Britain is as mixed as that of its inhabitants: the frequent introduction of foreign horses has given us a variety, that no single country can boast of: most other kingdoms produce only one kind; while ours, by a judicious mixture of the several species; by the happy difference of our soils; and by our superior skill in management, may triumph over the rest of Europe, in having brought each quality of this noble animal to the highest perfection.

In the annals of Newmarket, may be found instances of horses that have literally outstripped the wind, as the celebrated M. Condamine has lately shewn in his remarks on those of Great Britain. Childers, is an amazing instance of rapidity, his speed having been more than once exerted, equal to 82½ feet in a second, or near a mile in a minute: the same horse has also run the round course at Newmarket, (which is about 400 yards less than four miles,) in six minutes and forty seconds: in which case his fleetness is to that of the swiftest barb, as four to three; the former, according to Dr. Maty's computation, covering at every bound a space of ground, equal in length to twenty-three feet royal; the latter only that of eighteen feet and a half royal.

Horses of this kind, derive their origin from Arabia; the seat of the purest, and most generous breed.

The species used in hunting, is a happy combination of the former with others superior in strength, but inferior in point of speed and lineage: an union of both is necessary: for the fatigues of the chace must be supported by the spirit of the one, as well as by the vigour of the other.

No country can bring a parallel to the strength and size of our horses destined for the draught; or to the activity and strength united, of those that form our cavalry.

In our capital there are instances of single horses that are able to draw on a plain, for a small space, the weight of three tons; but could with ease, and for a continuance, draw half that weight. The pack-horses of Yorkshire, employed in conveying the manufactures of that county to the most remote parts of the kingdom, usually carry a burden of 420 pounds; and that indifferently over the highest hills of the north, as well as the most level roads; but the most remarkable proof of the strength of our British horses, is to be drawn from that of our mill-horses; some of these will carry at one

load thirteen measures, which at a moderate computation of 70 pounds each, will amount to 910; a weight superior to that which the lesser sort of camels will bear: this will appear less surprising, as these horses are by degrees accustomed to the weight; and the distance they travel no greater than to and from the adjacent hamlets.

Our cavalry, in the late campaigns, (when they had an opportunity) shewed, over those of our allies, as well as of the French, a great superiority both of strength and activity: the enemy was broken through by the impetuous charge of our squadrons; while the German horses, from their great weight and inactive make, were unable to second our efforts; though those troops were actuated by the noblest ardour.

The present cavalry of this island only supports its ancient glory; it was eminent in the earliest times: our scythed chariots, and the activity and good discipline of our horses, even struck terror into Cæsar's legions: and the Britons, as soon as they became civilized enough to coin, took care to represent, on their money, the animal for which they were so celebrated. It is now impossible to trace out this species; for those which exist among the *indigenæ* of Great Britain, such as the little horses of Wales and Cornwall, the hobbies of Ireland, and the shelties of Scotland, though admirably well adapted to the uses of those countries, could never have been equal to the work of war; but, probably, we had even then a larger and stronger breed in the more fertile and luxuriant parts of the island. Those we employ for that purpose, or for the draught, are an offspring of the German or Flemish breed, meliorated by our soil, and a judicious culture.

The English were ever attentive to an exact culture of these animals; and in very early times set a high value on their breed. The esteem that our horses were held in by foreigners, so long ago as the reign of Athelstan, may be collected from a law of that monarch prohibiting their exportation, except they were designed as presents. These must have been the native kind, or the prohibition would have been needless; for our commerce was, at that time, too limited to receive improvement from any but the German kind, to which country their own breed could be of no value.

But when our intercourse with the other parts of Europe was enlarged, we soon laid hold of the advantages this gave of improving our breed. Roger de Bellesme, Earl of Shrewsbury, is the first that is on record: he introduced the Spanish stallion into his estate,

in Powisland, from which that part of Wales was for many ages celebrated for a swift and generous race of horses. Giraldus Cambrensis, who lived in the reign of Henry II. takes notice of it; and Michael Drayton, contemporary with Shakespeare, sings their excellence in the sixth part of his Polyolbion. This kind was, probably, destined to mount our gallant nobility, or courteous knights for feats of chivalry, in the generous contests of the tilt-yard. From these sprung, to speak the language of the times, the flower of coursers, whose elegant form added charms to the rider; and whose activity, and managed dexterity, gained him the palm in that field of gallantry and romantic honour.

Notwithstanding my former supposition, races were known in England in very early times. *Fitz-Stephen*, who wrote in the days of Henry II. mentions the great delight that the citizens of London took in the *diversion*. But by his words, it appears not to have been designed for the purposes of gaming, but merely to have sprung from a generous emulation of shewing a superior skill in horsemanship.

Races appear to have been in vogue in the reign of queen Elizabeth, and to have been carried to such excess as to injure the fortunes of the nobility. The famous George, Earl of Cumberland, is recorded to have wasted more of his estate than any of his ancestors; and chiefly by his extreme love to horse-races, tiltings, and other expensive diversions. It is probable that the parsimonious queen did not approve of it; for races are not among the diversions exhibited at Kennelworth, by her favourite Leicester. In the following reign, were places allotted for the sport: Croydon, in the south, and Garterly, in Yorkshire, were celebrated courses. Camden also says, that, in 1607, there were races near York, and the prize was a little golden bell.

Not that we deny this diversion to be known in these kingdoms in earlier times; we only assert a different mode of it, gentlemen being then their own jockies, and riding their own horses. Lord Herbert, of Cherbury, enumerates it among the sports that gallant philosopher thought unworthy of a man of honour. "The exercise," says he, "I do not approve of, is running of horses, there being much cheating in that kind; neither do I see why a brave man should delight in a creature whose chief use is to help him to run away."

The increase of our inhabitants, and the extent of our manufactures, together with the former neglect of internal navigation to convey those manufactures, multiplied the number of our horses;

an excess of wealth, before unknown in these islands, increased the luxury of carriages, and added to the necessity of an extraordinary culture of these animals: their high reputation abroad has also made them a branch of commerce, and proved another cause of their vast increase.

As no kingdom can boast of parallel circumstances, so none can vie with us in the number of these noble quadrupeds: it would be extremely difficult to guess at the exact amount of them, or to form a periodical account of their increase: the number seems very fluctuating: William Fitz-Stephen relates, that in the reign of King Stephen, London alone poured out 20,000 horsemen in the wars of those times: yet we find that in the beginning of Queen Elizabeth's reign, the whole kingdom could not supply two thousand horses to form our cavalry: and even in the year 1588, when the nation was in the most imminent danger from the Spanish invasion, all the cavalry, which the nation could then furnish, amounted only to 3000; to account for this difference we must imagine, that the number of horses which took the field in Stephen's reign, was no more than an undisciplined rabble; the few that appeared under the banners of Elizabeth, a corps well formed, and such as might be opposed to so formidable an enemy as was then expected: but such is their present increase, that, in the late war, the number employed was upwards of 30,000; and such is our improvement in the breed of horses, that most of those which are used in our waggons and carriages of different kinds, might be applied to the same purpose: of these, our capital alone employs about 22,000.

Buffon has almost exhausted the subject of the natural history of the horse, and the other domestic animals; and left very little for after writers to add. We may observe, that this most noble and useful quadruped is endowed with every quality that can make it subservient to the uses of mankind: and those qualities appear in a more exalted, or in a less degree, in proportion to our various necessities.

Undaunted courage, added to a docility half reasoning, is given to some, which fits them for military services. The spirit and emulation so apparent in others, furnish us with that species, which is admirably adapted for the course; or, the more noble and generous pleasure of the chace.

Patience and perseverance appear strongly in that most useful kind destined to bear the burdens we impose on them; or that employed in the slavery of the draught.

Though endowed with vast strength and great powers, they very rarely exert either to their master's prejudice; but on the contrary will endure fatigues even to death, for our benefit. Providence has implanted in them a benevolent disposition, and a fear of the human race, together with a certain consciousness of the services we can render them. Most of the hoofed quadrupeds are domestic, because necessity compels them to seek our protection: wild beasts are provided with feet and claws, adapted to the forming dens and retreats from the inclemency of the weather; but the former, destitute of these advantages, are obliged to run to us for artificial shelter, and harvested provisions: as nature, in these climates, does not throughout the year supply them with necessary food.

But still, many of our tame animals must by accident endure the rigour of the season: to prevent which inconvenience, their feet (for the extremities suffer first by cold) are protected by strong hoofs of a horny substance.

The tail too is guarded with long bushy hair, that protects it in both extremes of weather; during the summer it serves, by its pliancy and agility, to brush off the swarms of insects which are perpetually attempting either to sting them, or deposit their eggs in the rectum; the same length of hair contributes to guard them from the cold in winter. But we, by the absurd and cruel custom of docking, a practice peculiar to our country, deprive these animals of both advantages: in a former war our cavalry suffered so much on that account, that we have seen the error; and if we may judge from some recent orders in respect to that branch of the service, it will for the future be corrected.

Thus is the horse provided against the two greatest evils he is subject to from the seasons: his natural diseases are few; but our ill usage, or neglect, or, which is very frequent, our over care of him, brings on a numerous train, which are often fatal. Among the distempers he is naturally subject to, are the worms, the bots, and the stone: the species of worms that infect him, are the lumbrici, and ascarides; both these resemble those found in human bodies, only larger: the bots are the erucæ, or caterpillars of the oestrus, or gadfly: these are found both in the rectum, and in the stomach, and when in the latter bring on convulsions, that often terminate in death.

The stone is a disease the horse is not frequently subject to; yet we have seen two examples of it; the one in a horse, near High Wycombe, that voided sixteen calculi, each of an inch and a half

diameter; the other was of a stone taken out of the bladder of a horse, and deposited in the cabinet of the late Dr. Mead; weighing eleven ounces. These stones are formed of several crusts, each very smooth and glossy; their form triangular; but their edges rounded, as if by collision against each other.

The all-wise Creator hath finely limited the several services of domestic animals towards the human race; and ordered that the parts of such, which in their lives have been the most useful, should after death contribute the least to our benefit. The chief use that the exuviæ of the horse can be applied to, is for collars, traces, and other parts of the harness; and thus, even after death, he preserves some analogy with his former employ. The hair of the mane is of use in making wigs; of the tail in making the bottoms of chairs, floor-cloths, and cords; and to the angler in making lines.

[*Linnæus. Pennant. Turton.*

SECTION XI.

Quagga.

Equus quagga.—Linn.

This beautiful animal was till lately confounded with the Zebra. It is now, however, acknowledged to be a distinct species, though closely allied to it, but marked with fewer and larger bands, which are of a browner colour than in the zebra, and are chiefly disposed on the fore parts of the animal; while the hind parts are rather spotted than striped. The ground colour also of the quagga is of a ferruginous tinge, especially on the thighs and back. It is of a milder or more docile nature than the zebra, and is said to have been successfully used by some of the Dutch colonists at the Cape, in the manner of a horse, for draught, &c. It inhabits the same parts of Africa as the Zebra, but is found in separate herds; never associating with that species.

[*Pennant. Shaw.*

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QUAGGA,

Equus Quagga Linn.